JRC Scientific and Technical Reports

European Innovation Scoreboard 2006:

Strengths and Weaknesses Report

Stefano Tarantola and Debora Gatelli

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Executive summary

This report aims at analyzing behaviour in innovation performance at country level, in order to highlight strengths and weaknesses of the countries considered in the European Innovation Scoreboard (EIS) 2006.

The 25 indicators of the EIS are considered for a total of 34 countries; the EU27, other candidate countries and some of the EFTA countries are described and put side by side with countries such as US and Japan.

An analysis by innovation category shows that Europe[1] is lagging behind United States[2] and Japan with regard to *innovation drivers*, *knowledge creation* and *intellectual property*. For the remaining two innovation categories (i.e., *innovation & entrepreneurship* and *applications*) the available evidence does not allow to draw any inference.

A more detailed look at the five innovation groups highlights some peculiar differences between Europe and its competitors.[3]

Europe is ahead in the following areas:

- New graduates in science and engineering are 13‰ of population aged 20-29 in Europe and in Japan (2004 data), but only 10‰ in US (2004 data).

- In Europe and Japan, employment in manufacturing industries that produce medium/high and high-tech goods (7% of total workforce in 2003) is almost twice than that in the US (4% in 2003). In Europe this indicator has declined by a few decimal points in 2005.

- European trading companies (101 trademarks per million populations in 2005) have obtained a much larger number of new Community Trademarks than US companies (34 trademarks in 2005) and Japanese companies (only 12 trademarks in 2005). These figures reflect the fact that Community trademarks are intended to facilitate trade activities in the Member States of the European Union.

- The number of Community designs is, expectedly, also very high in Europe (111 new designs per million population in 2005) with respect to US and Japan (18 and 13 new designs, respectively, in 2005). These results are also consistent with the fact that Community designs are intended to facilitate the protection of the outward appearance of products that are sold in the European market.

[1] At the time of data compilation and writing this report, Bulgaria and Romania were still not Members of the European Union. So, the words *Europe* or *European Union* in this report refer to the EU25 aggregate.
[2] Consider that many indicators for both United States and Japan are missing and the available ones often refer to prior 2005.
[3] When 2005 data was not available, information were drawn from previous years.

On the other hand, Europe is lagging behind its competitors in a number of important aspects:

- In 2004, the expenditure of Japanese business in R&D (2.4% of GDP) amounted to twice the expenditures in Europe (1.2% of GDP). In the United States such expenditures stabilized to around 1.9% of GDP.

- ICT expenditure in 2005 (6.7% of GDP in US, 7.6% in Japan, and only 6.4% in Europe).

- Broadband penetration rates for 2005 were 11% for EU25 and almost 15% for the US, whilst Japan was above 16%. The range for European countries varies from 1% to 22%.

- In 2003, the population with tertiary education was 38% in the US and 37% in Japan, whilst – in 2005 – it was still only 23% in Europe. The figures for the Scandinavian countries are around 30%.

- In the United States, venture capital investments at the early stage of activity of a company in 2002 (0.072% of GDP) were more than three times larger than the investments in Europe in 2005 (0.023% of GDP). No data are available for Japan.

- In 2004, 26.8% of total exports of goods in US was in high-tech products, 22.4% in Japan, and only 18.4% in Europe;

- The patents granted by the US patent office and the triadic patent families (those for which there is evidence of patenting activity in all blocks, i.e. EPO, USPTO and JPO), are a hegemony of the US and Japan. The number of patent applications filed at the European patent office (for which Europe as a home advantage) is again slightly in favor of our competitors (data of 2003).

Some indicators show a remarkable trend, although further progress is still needed to close the remaining gap. In the group *innovation drivers*, the indicator of broadband penetration rate has increased its score by 60% since 2004, going from 6.5 to 10.6 broadband lines per 100 populations in 2005.

Three indicators in the group of *intellectual property* have also increased significantly. These are:

- new applications to the European patent office, which have shown an annual average growth rate of 3.7% (increasing from 114 per million population in 1998, to 137 in 2003);

- new Community trademarks, which have had an annual average growth rate of 11%, increasing from 66 to 101 new trademarks per million population between 2001 and 2005;

- new Community designs, which have shown an annual average growth rate of 18% from 2003 to 2005, increasing from 79.6 to 110.9 new designs per million population.

On the other hand, the indicators for early stage venture capital (in the group *innovation & entrepreneurship*) and new-to-firms sales (in the group *applications*) have halved their values between 2000 and 2004.

Determining the common drivers of the European innovation process is not a univocal process; in fact, the innovation patterns depend strongly on a heterogeneous mix of variables. This report on strengths and weaknesses provides additional details on levels and trends at country level.

Introduction

This report summarizes the strengths and weaknesses in the innovation performance of 34 countries, including the 27 Member States of the European Union, two Candidate Countries (Turkey and Croatia), Norway, Switzerland, Iceland, Japan and United States.

The report uses data from the European Innovation Scoreboard 2006, which includes 25 indicators grouped into two broad themes, inputs and outputs, and classified into five dimensions[4]. Innovation inputs include three dimensions:

- *Innovation drivers* (5 indicators) to measure the structural conditions required for innovation potential,
- *Knowledge creation* (4 indicators) to measure the investments in R&D activities, and
- *Innovation & entrepreneurship* (6 indicators) to measure the efforts towards innovation at the firm level.

Innovation outputs include two dimensions:

- *Applications* (5 indicators) to measure the performance expressed in terms of labour and business activities and their added value in innovative sectors, and
- *Intellectual property* (5 indicators) to measure the achieved results in terms of successful know-how.

[4] These dimensions have been defined in the 2005 EIS methodology report from the Joint Research Centre (http://trendchart.cordis.lu/scoreboards/scoreboard2005/scoreboard_papers.cfm).

Table 1 shows the 5 categories, the 25 indicators, and the primary data sources for each indicator[5].

TABLE 1: EIS 2006 INDICATORS

	INPUT – INNOVATION DRIVERS	
1.1	Science & Engineering graduates per 1000 population aged 20-29	EUROSTAT
1.2	Population with tertiary education per 100 population aged 25-64	EUROSTAT, OECD
1.3	Broadband penetration rate (number of broadband lines per 100 population)	EUROSTAT
1.4	Participation in life-long learning per 100 population aged 25-64	EUROSTAT
1.5	Youth education attainment level (% of population aged 20-24 having completed at least upper secondary education)	EUROSTAT
	INPUT – KNOWLEDGE CREATION	
2.1	Public R&D expenditures (% of GDP)	EUROSTAT, OECD
2.2	Business R&D expenditures (% of GDP)	EUROSTAT, OECD
2.3	Share of medium-high-tech and high-tech R&D (% of manufacturing R&D expenditures)	EUROSTAT, OECD
2.4	Share of enterprises receiving public funding for innovation	EUROSTAT (CIS4)
	INPUT – INNOVATION & ENTREPRENEURSHIP	
3.1	SMEs innovating in-house (% of all SMEs)	EUROSTAT (CIS3)[6]
3.2	Innovative SMEs co-operating with others (% of all SMEs)	EUROSTAT (CIS4)
3.3	Innovation expenditures (% of total turnover)	EUROSTAT (CIS4)
3.4	Early-stage venture capital (% of GDP)	EUROSTAT
3.5	ICT expenditures (% of GDP)	EUROSTAT
3.6	SMEs using organisational innovation (% of all SMEs)	EUROSTAT (CIS4)
	OUTPUT – APPLICATIONS	
4.1	Employment in high-tech services (% of total workforce)	EUROSTAT
4.2	Exports of high technology products as a share of total exports	EUROSTAT
4.3	Sales of new-to-market products (% of total turnover)	EUROSTAT (CIS4)
4.4	Sales of new-to-firm products (% of total turnover)	EUROSTAT (CIS4)
4.5	Employment in medium-high and high-tech manufacturing (% of total workforce)	EUROSTAT
	OUTPUT – INTELLECTUAL PROPERTY	
5.1	Patent applications at the European Patent Office (EPO) per million population	EUROSTAT
5.2	Patents granted at the US Patent and Trademark Office (USPTO) per million pop.	EUROSTAT, OECD
5.3	Triadic patent families per million population	EUROSTAT, OECD
5.4	New community trademarks per million population	OHIM[7]
5.5	New community designs per million population	OHIM[7]

The definitions of the indicators and their relevance to the Scoreboard are given in Annex Table C of the European Innovation Scoreboard. The European Innovation Scoreboard contains data for the period 1998 – 2005. However, most of the data are available from 2000 to 2004. According to the procedure established in the Innovation Scoreboard 2005, it has been decided not to impute the missing data, but using instead the most recent available data in order to have the most complete picture as possible. In the report, the latest available data are represented in horizontal bar charts accompanied by a country profile text. The indicators in the graphs are displayed in indexed form, where the EU25 aggregate level is set at 100.

[5] National data sources were used for several indicators where Eurostat or OECD data were not available. In particular, the statistical offices from Malta and Switzerland provided valuable support.

[6] CIS4 data for the indicator on the share of SMEs innovating in-house were not available in the data released by Eurostat (NewCronos website).

[7] Office for Harmonization in the Internal Market (Trade Marks and Designs).

The individual country data sheets are reported in the Annex to this document. In these data sheets it is possible to find the data for the 25 indicators over the time period (1998-2005), indexed scores using 100 as the EU25 average for a given year, and the most recent year of data availability for each indicator.

In the next section, a country profile is given for each of the 34 countries. Each country profile includes the performance of the innovation groups for the most recent year available, highlights on single indicators and significant trends across the short (~1 years) and medium term (~5 year).

Acknowledgements

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Country Profiles

AUSTRIA

Overall performance

The innovation performance of Austria is slightly above the EU average. Available indicators show that both Innovation drivers and Intellectual Property are the innovation dimensions with best results. Innovation drivers, broadband penetration rate (11.6 lines per 100 population), participation in life-long learning (13.8% of active population) and attainment level of youth education (86% of young people have completed at least upper secondary education) are all above the EU25 average. For Intellectual Property, particularly important contributions are given by new Community trademarks and new Community industrial designs, both well above the EU25 average. On the other hand, investment in early-stage venture capital can still improve (presently at one third of the EU25 level).

In the group Innovation Drivers, there is potential to increase the number of new graduates in Science and Engineering (only 8.7 graduates per thousand population aged 20-29) and the number of people with tertiary education (17.8% per hundred population aged 25-64), which are still below the EU25 level.

Trend

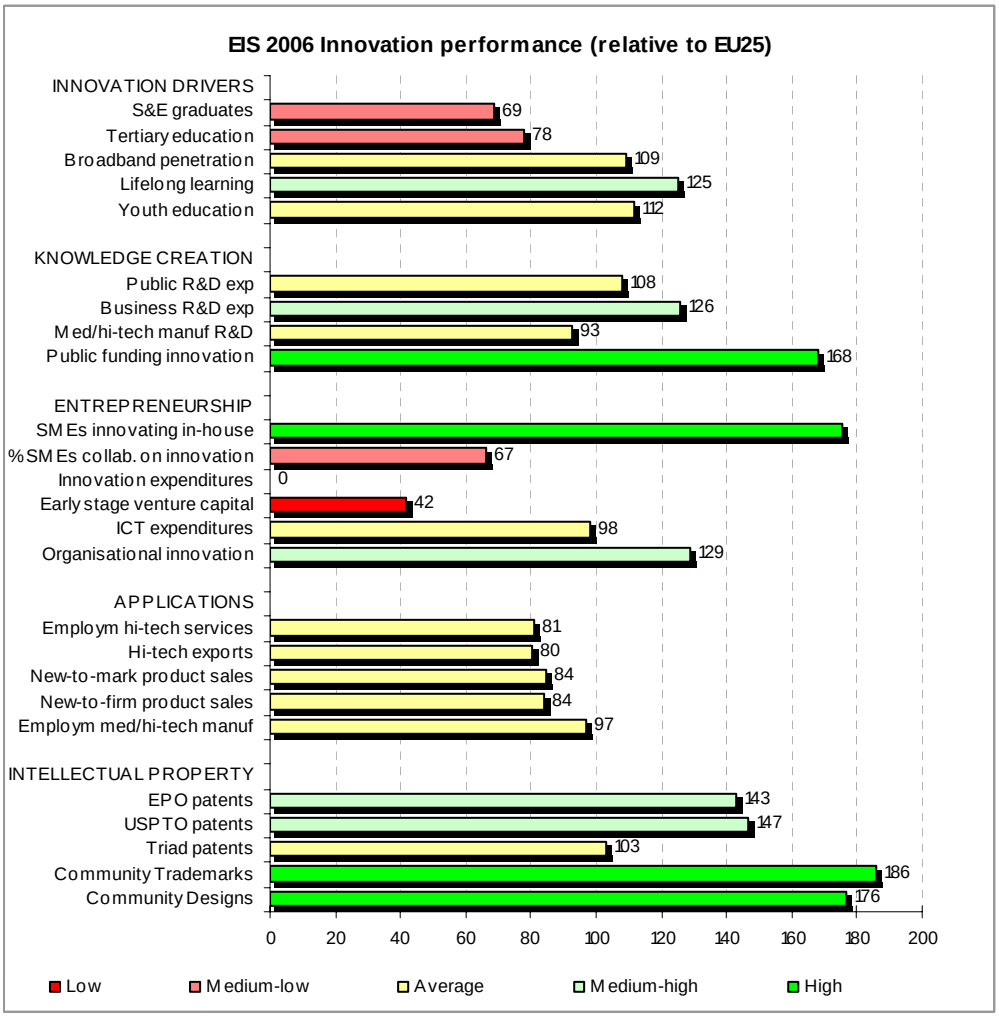
Since 1999 Austria has improved its innovation performance in several groups, especially in Knowledge Creation and Intellectual property. Efforts have been made to increase R&D expenditures in the business sector (from 1.12% of GDP in 1998 to 1.51% in 2004) and to increase new applications to the European Patent Office (from 134.3 new applications per million population in 1998 to 195.1 in 2003, corresponding to an annual average growth rate of 7.8%).

On the other hand, public funding to enterprises and sales of new-to-firm and new-to market products have declined in the last four years; their performance was much higher than the European average in 2000 and they are now more or less aligned with the EU25.

Tertiary education has grown relatively rapidly with respect to other countries (from 14.1 persons in age class 25-64 with some form of post-secondary education in year 2000, to 17.8 in 2005). In addition, the number of new graduates in Science and Engineering has increased at the same pace as

the European average. Yet, for these two aspects of education more effort is needed to catch up with the EU25 level.

Figure: Austria



BELGIUM

Overall performance

The overall performance of Belgium is slightly above the EU average, with several indicators above the EU25 average and only a couple of indicators below the average.

Most recent available data for year 2005 show that the group of Innovation drivers is the better performing with a high participation in tertiary education and a high level of broadband penetration. High level of education in the country positively affects the group application, which shows a consistent concentration of employment in high-tech services and manufacturing.

Considering the latest available data for each indicator, the group Innovation & entrepreneurship shows high percentages of SMEs innovating in house or cooperating on innovation. The Knowledge creation dimension is well supported by a significant share of enterprises receiving public funding for innovation.

High-tech exports and new-to-market product sales are areas which offer room for improvement.

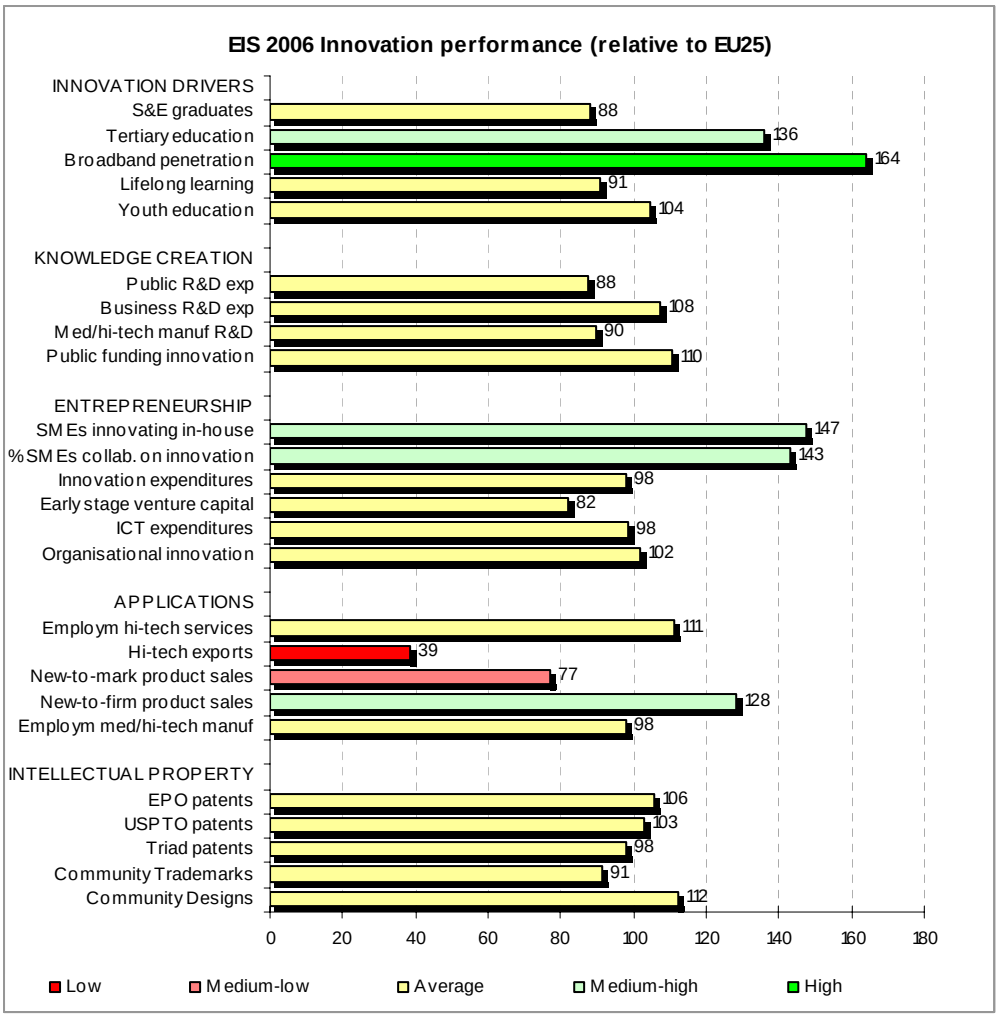
Trend

Since 1998, the trend of innovation performance in Belgium has been constantly positive, although Belgium does not display the same rate of growth as the EU25 average. Progress took place especially in Innovation & entrepreneurship (indicators on innovative SMEs and ICT expenditures). On the other hand, the indicators for business R&D expenditures and new community trademarks have shown no sign of improvement in the medium term. An exception is early stage venture capital, which started to gain ground in the years 2004-2005.

Concerning the group Applications, there has been a positive trend for the new-to-market product sales indicator, while the indicator for high-tech exports has remained below average.

Amongst Innovation drivers, the indicator for S&E graduates has displayed a positive evolution while participation in life-long learning is stagnating.

Figure: Belgium



BULGARIA

Overall performance

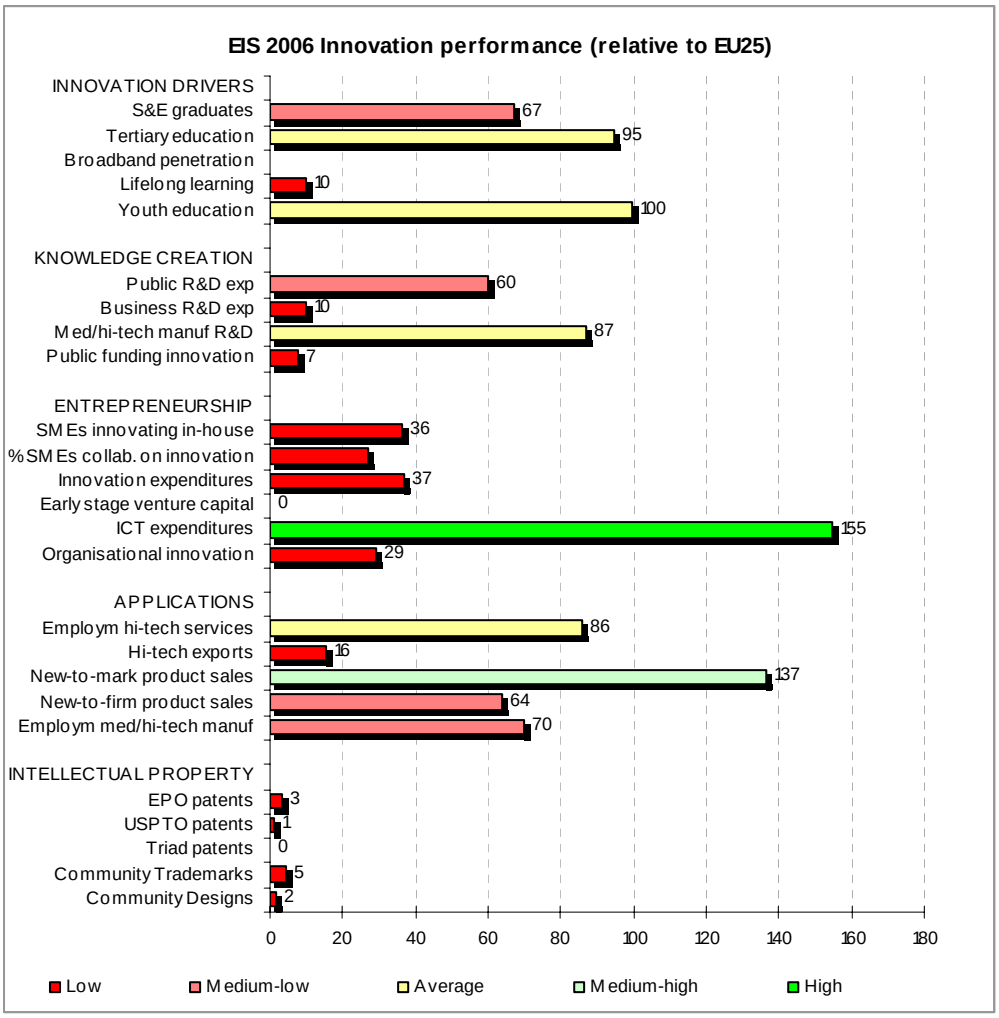
Innovation performance in Bulgaria is well below the EU average. An exception is youth education attainment, which seems to be a significant strength in Bulgaria. Considering the latest available data for each indicator, two indicators are particularly strong: ICT expenditures and new-to-market product sales; the majority of the other indicators being below the EU25 average. Particular attention should be paid to all indicators in intellectual property.

Trend

Bulgaria has experienced consistent improvements over time in a number of areas, although strong efforts are still needed in order to converge to the EU25 average. The most positive trend took place in the group Application, where sales of new-to-market and new-to-firms products increased, together with employment in high-tech services. On the other hand, both medium/high-tech manufacturing employment and exports of high-tech products are stagnant.

While innovation & entrepreneurship improved, with an increase in ICT expenditures and with more SMEs reporting organizational innovation, business R&D and skills (life-long learning and S&E graduates) are not yet showing positive trends.

Figure: Bulgaria



CROATIA

Overall performance

A great amount of data is not available for Croatia and this makes it is difficult to draw meaningful conclusions about its innovation performance. The strongest indicators are represented by education attainment levels, where almost 94 persons aged 20-24 having completed at least upper secondary education and almost 22 persons with tertiary education per 100 population aged 25-64 in 2005. The

first indicator is above the EU25 average and stands out compared to other available indicators. Employment in medium-high manufacturing sector and in high-tech services are, respectively, 3.89% and 2.02% of total workforce in 2005, almost half of the European average levels. Considering 2004 data, public expenditures in R&D are 0.70% of GDP, slightly above the EU25.

Data are completely missing for the group *innovation & entrepreneurship* and *intellectual property* is the group with the weakest scores and the least recent information.

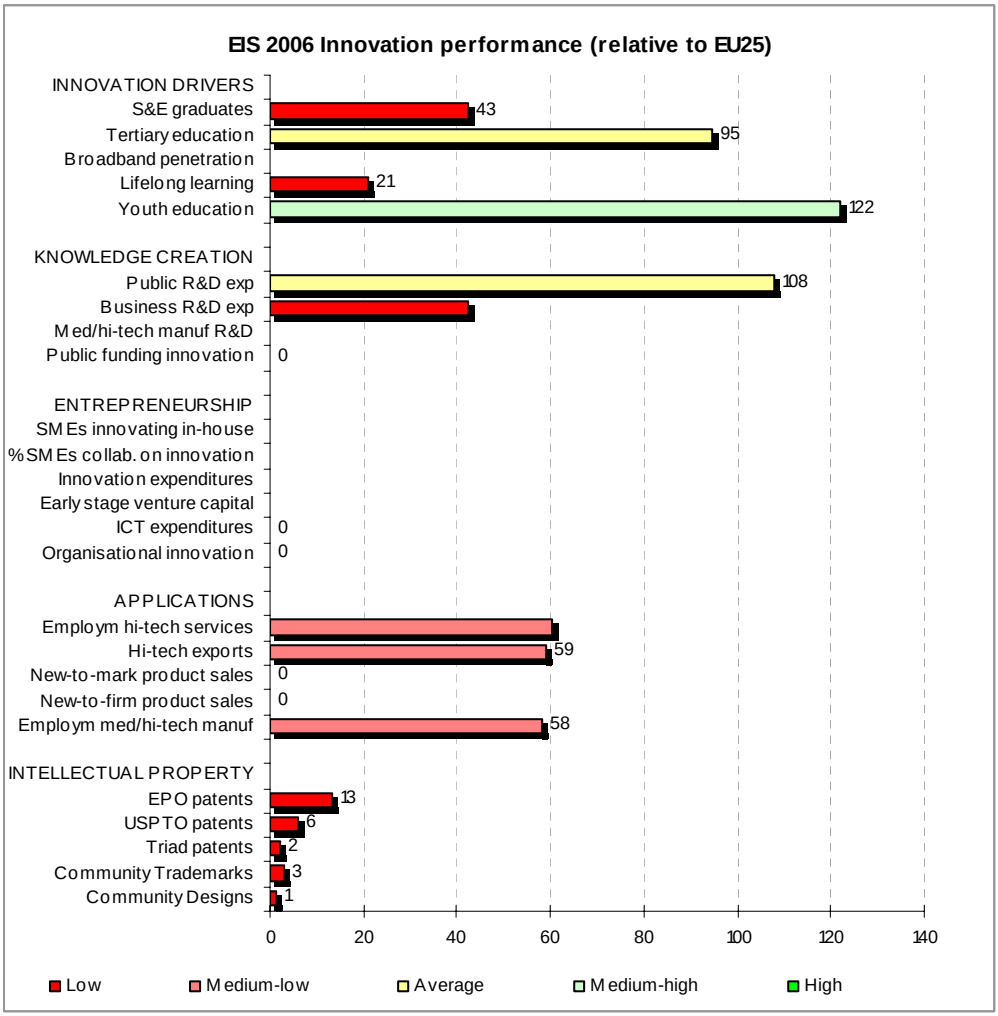
Trend

Trends in Croatia are difficult to analyze due to the scarcity of data. Some information worth noticing is that youth education attainment has increased from 90% of population aged 20-24 to 94% between 2002 and 2005; participation in lifelong learning has shown some increase only in the last year (2004-2005). Population with tertiary education increased from 18.2% of working age population to 21.6% in the period 2002 - 2005.

Public and business R&D expenditures have shown a positive trend from 2002 to 2004, even if business R&D expenditures are still far from the European average.

Negative trends have taken place for community trademarks and community industrial designs.

Figure: Croatia



CYPRUS

Overall performance

Innovation performance in Cyprus is below the EU average. Most of the available indicators for 2005 are below the EU-25 average. At the same time, youth education attainment and population with tertiary education contribute positively to the overall country's performance.

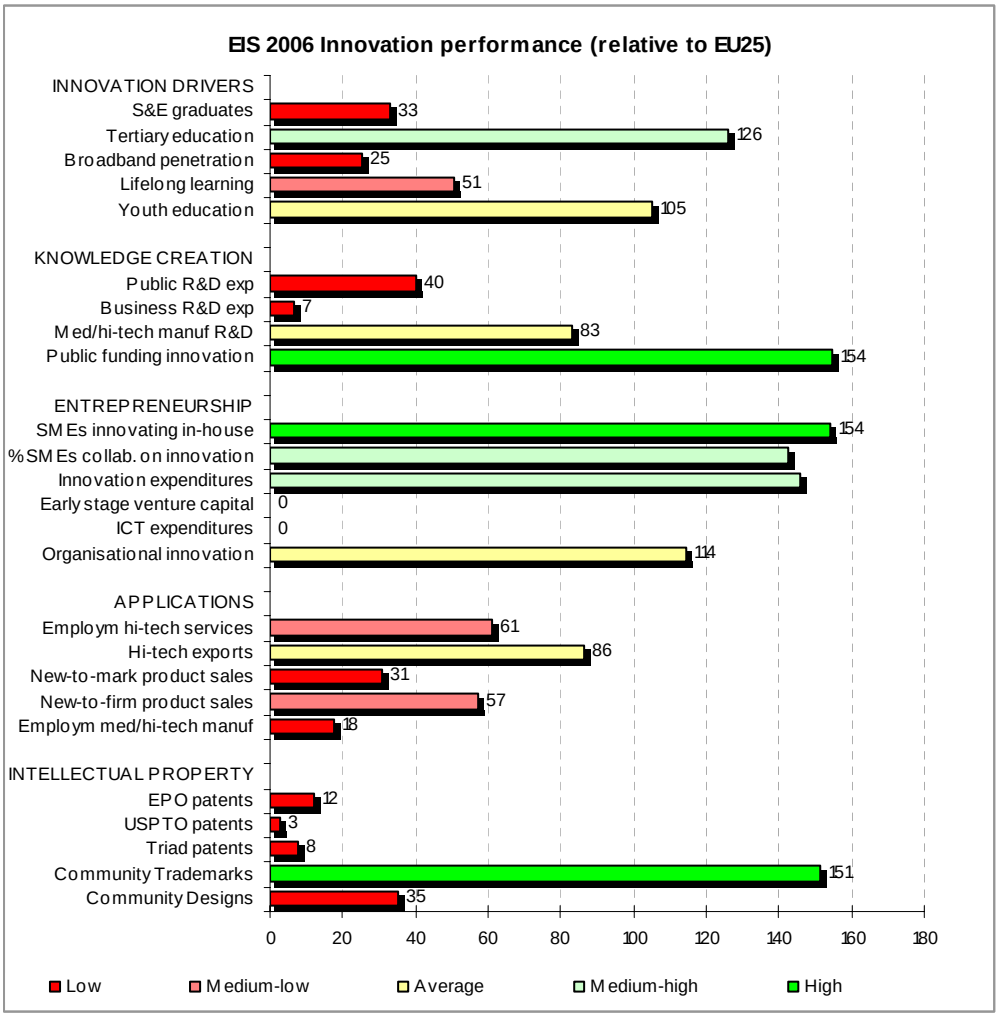
Community trademarks, in the group Intellectual property, and high-tech exports, in the group Applications, are two further strengths for Cyprus. R&D expenditures, in the group Knowledge creation, and patents, in the group Intellectual property, need to be improved in order to improve convergence to the EU25.

Trend

Despite the fact that the country's performance is still well below the EU25 average, its trend has been quite positive from 1998 to 2005. In particular, the group Applications has strongly increased in all

indicators (high-tech exports above all). On the other hand, the groups on Innovation drivers and Knowledge creation did not record significant improvement. There is scope for increasing the numbers of S&E graduates and the level of public R&D, which are stagnating at a low level. A marginal increase occurred on a short time trend in business R&D expenditures, but the level is still far from the EU average.

Figure: Cyprus



CZECH REPUBLIC

Overall performance

The Czech innovation performance is slightly below the EU average, but ahead of a number of former EU-15 countries. The group Applications is the strongest for innovation in the Czech Republic, while

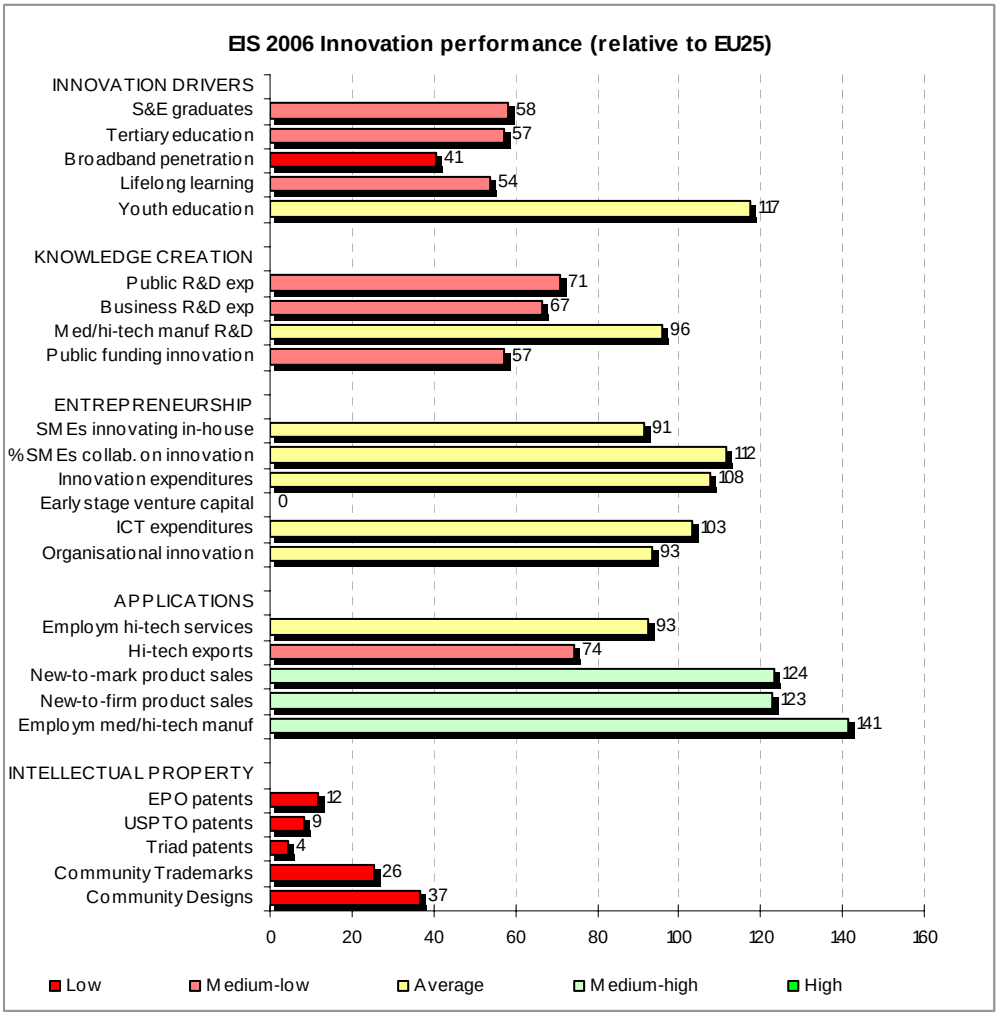
Intellectual property is the one with the weakest performance. The group Innovation & entrepreneurship is at the level of the EU25 average, while Knowledge creation and innovation drivers are below it with some indicators such as youth education and high tech manufacturing quickly approaching the EU25 average level.

Trend

Innovation & entrepreneurship and applications are the two groups experiencing the strongest increase over time. Above all, the trend has been positive for innovative SMEs cooperating with others and innovation expenditures, which have increased significantly.

The level of input into education offers substantial room for improvement, while, in recent years, the Knowledge creation group has had a slight increase in public and business R&D expenditures. They are still below the EU average.

Figure: Czech Republic



DENMARK

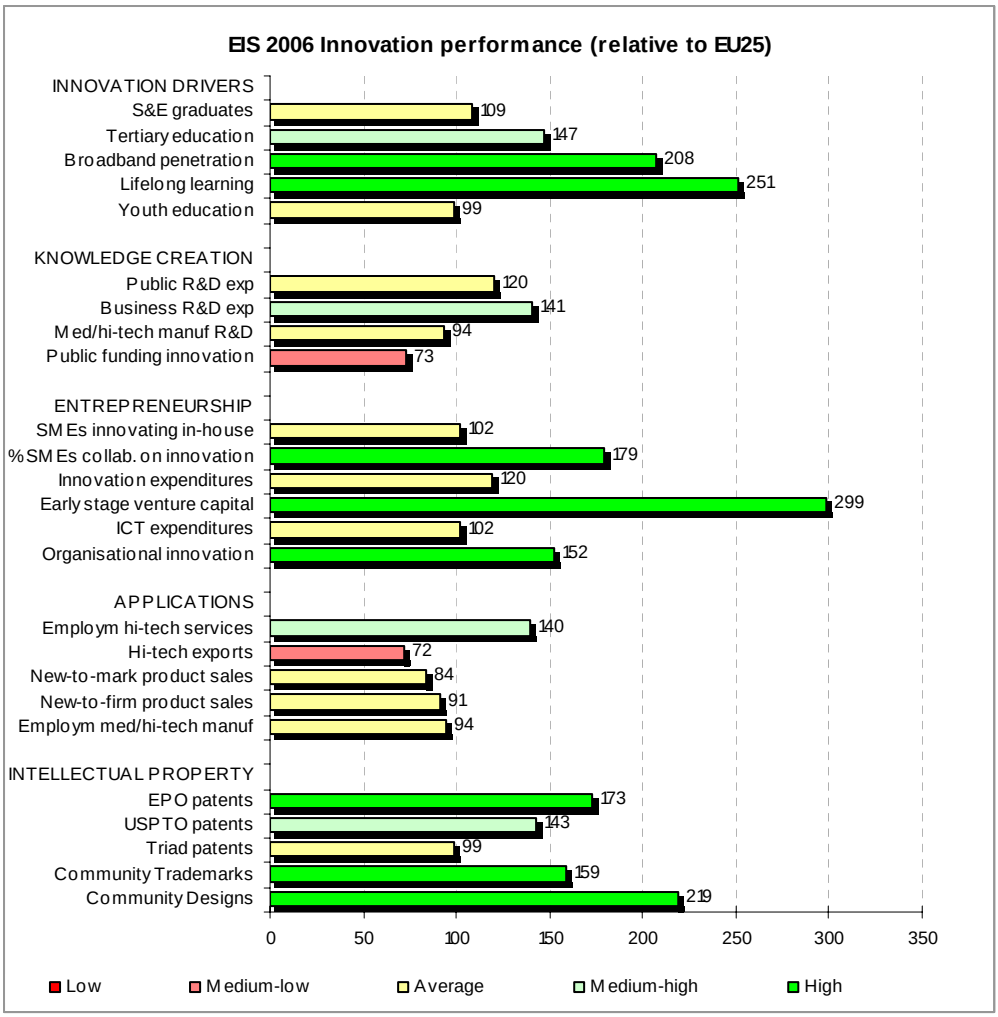
Overall performance

Denmark is among the top performing EU countries with an innovation performance well above the EU average. All five innovation dimensions show high scores of their indicators. Almost all available data for 2005 are largely above the EU25 average. Considering the latest available data for each indicator, the only weaker indicator is that of high-tech exports. All groups are performing well; particularly high scores are obtained for early stage venture capital, lifelong learning and community designs.

Trend

Denmark had a positive trend from 1998 to 2005; specifically, the Innovation & entrepreneurship group increased considerably in all its indicators. The group applications is the one with the most static behaviour: this suggests a possible field of further development. In the group Intellectual property triad patents and new community trademarks stagnated. Considering the last year (2004-2005), despite the high level achieved, the country continues to improve its score in several indicators, giving signs of a sustained innovation activity. For example, broadband penetration and early stage venture capital had very high scores in 2004, but their trend continues to be highly positive.

Figure: Denmark



ESTONIA

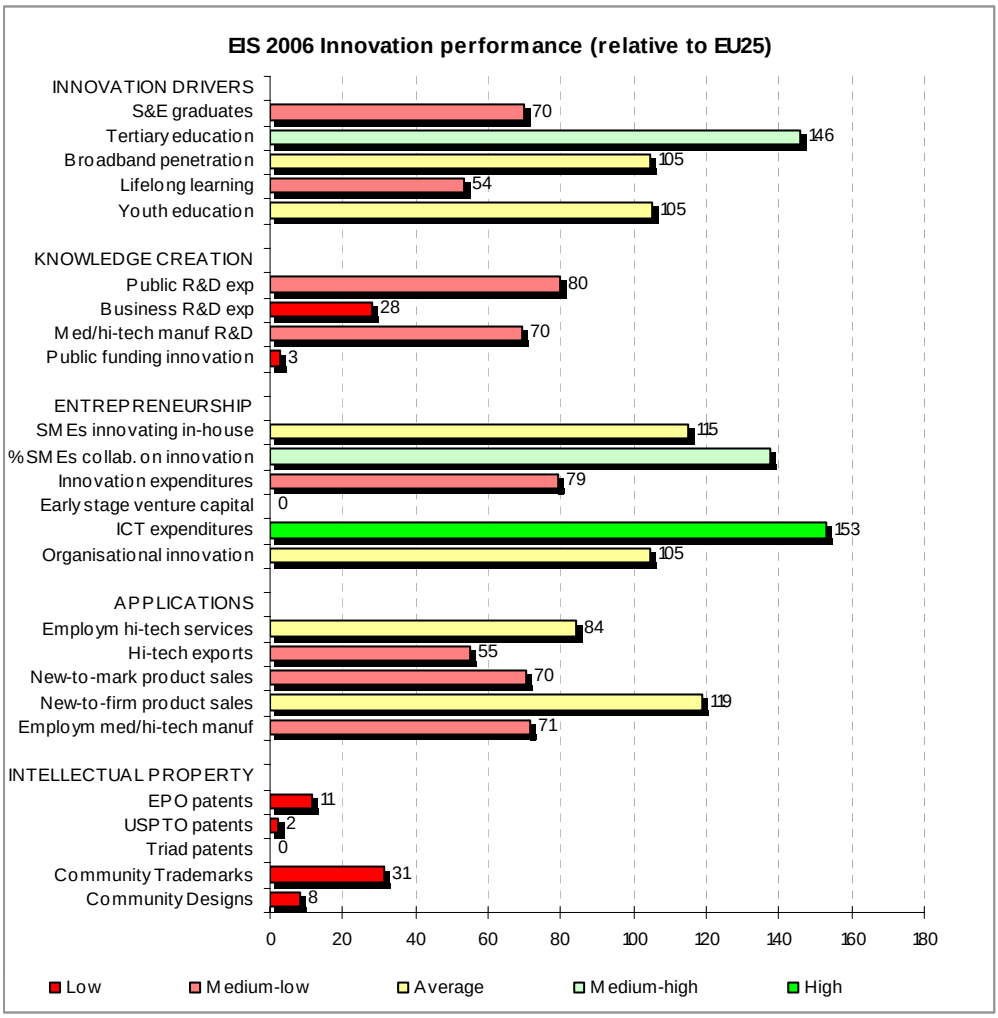
Overall performance

Estonia's innovation performance is below the EU average, but in general above that of most new Member States. Considering the latest available data for each indicator, Estonia shows strength in tertiary education, SMEs collaborating with others and ICT expenditures. The group of indicators on Intellectual property and Knowledge creation are pointing to some weaknesses. In particular, public funding for innovation and business R&D can improve further.

Trend

The groups Innovation & entrepreneurship and Applications show a positive trend with the majority of indicators experiencing a consistent increase. Areas for improvement include the low levels of investments in R&D and the scarcity of resources allocated to supply of skilled labour.

Figure: Estonia



FINLAND

Overall performance

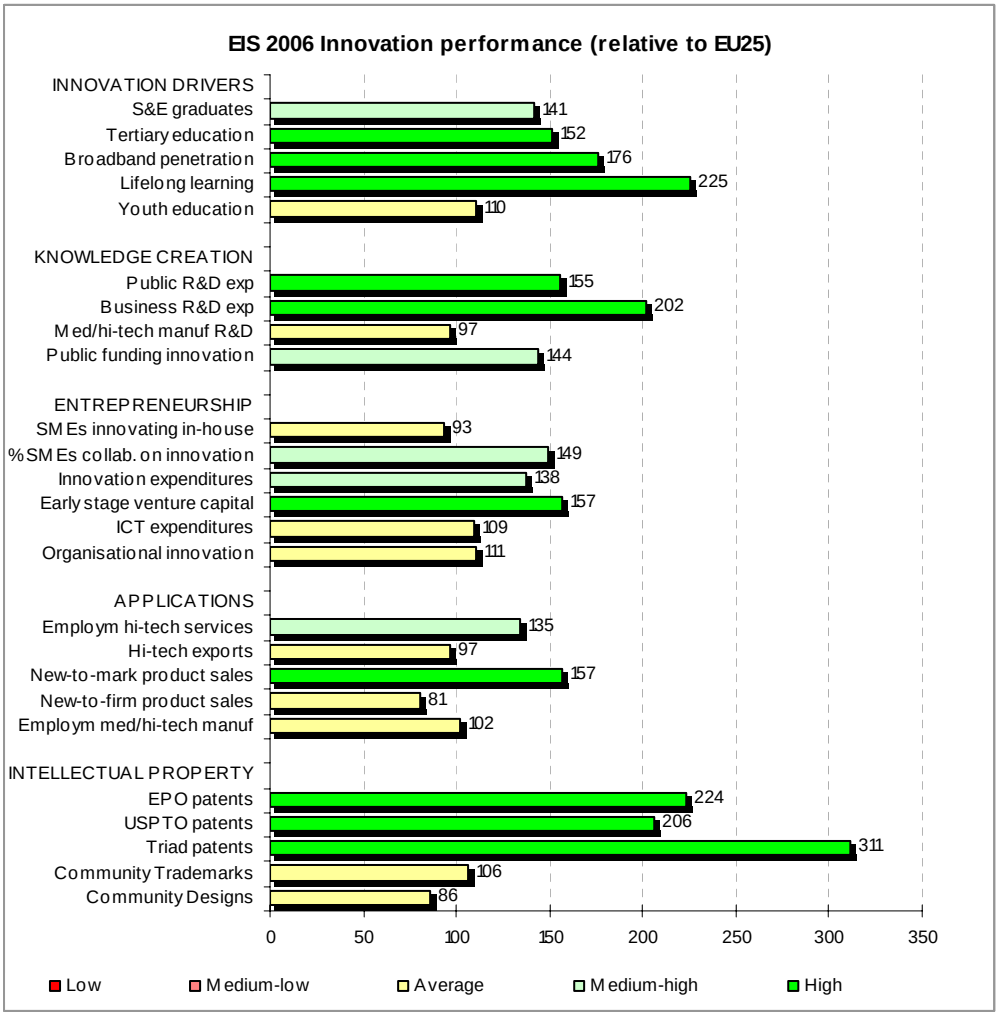
Finland is among the top performing EU countries with an innovation performance well above the EU average. The situation is very positive overall; the only exception is for intellectual property where new community trademarks and new community industrial designs are below the level of the rest of the indicators. Considering the latest available data for each indicator, the highest strengths are for triad patents and patents in general, together with participation in lifelong learning.

Trend

The trend in Finland broadly follows the general trend in the EU25. However, S&E graduates, population with tertiary education, participation in lifelong learning and new community trademarks

are growing less quickly than the EU average. Sales of new-to-firm products and enterprises receiving public funding have a negative growth and deserve attention.

Figure: Finland



FRANCE

Overall performance

The level of innovation performance in France is slightly below the EU average. There are few indicators under the EU25 average (participation in lifelong learning, public funding of innovation, community trademarks and designs), while one indicator is particularly high (S&E graduates).

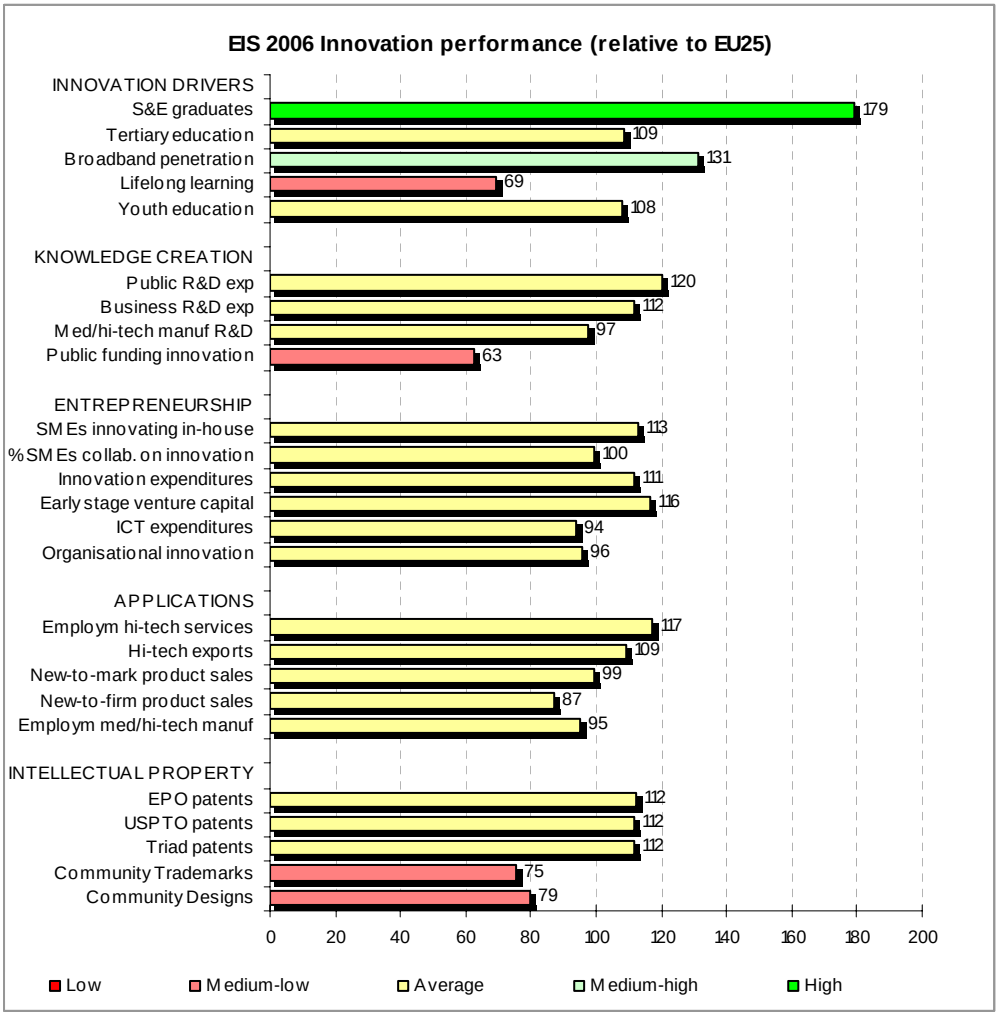
The 2005 data show Innovation drivers, Knowledge creation and Applications as the strongest groups; however, indicators for Intellectual property are weaker, particularly Community trademarks and designs.

Trend

The trend is positive, mainly in Innovation & entrepreneurship, where ICT expenditures and organizational innovation have increased. Other areas of positive growth include S&E graduates and sales of new to market products.

During the years 2004-2005, the country developed consistently its broadband penetration, youth education attainment level and early stage venture capital. On the other hand, business R&D expenditures remain stagnant. Tertiary education and participation in lifelong learning are not improving.

Figure: France



GERMANY

Overall performance

Germany is among the top performing EU countries with an innovation performance well above the EU average. Among the available data for 2005, Knowledge creation and Application are the sectors performing best.

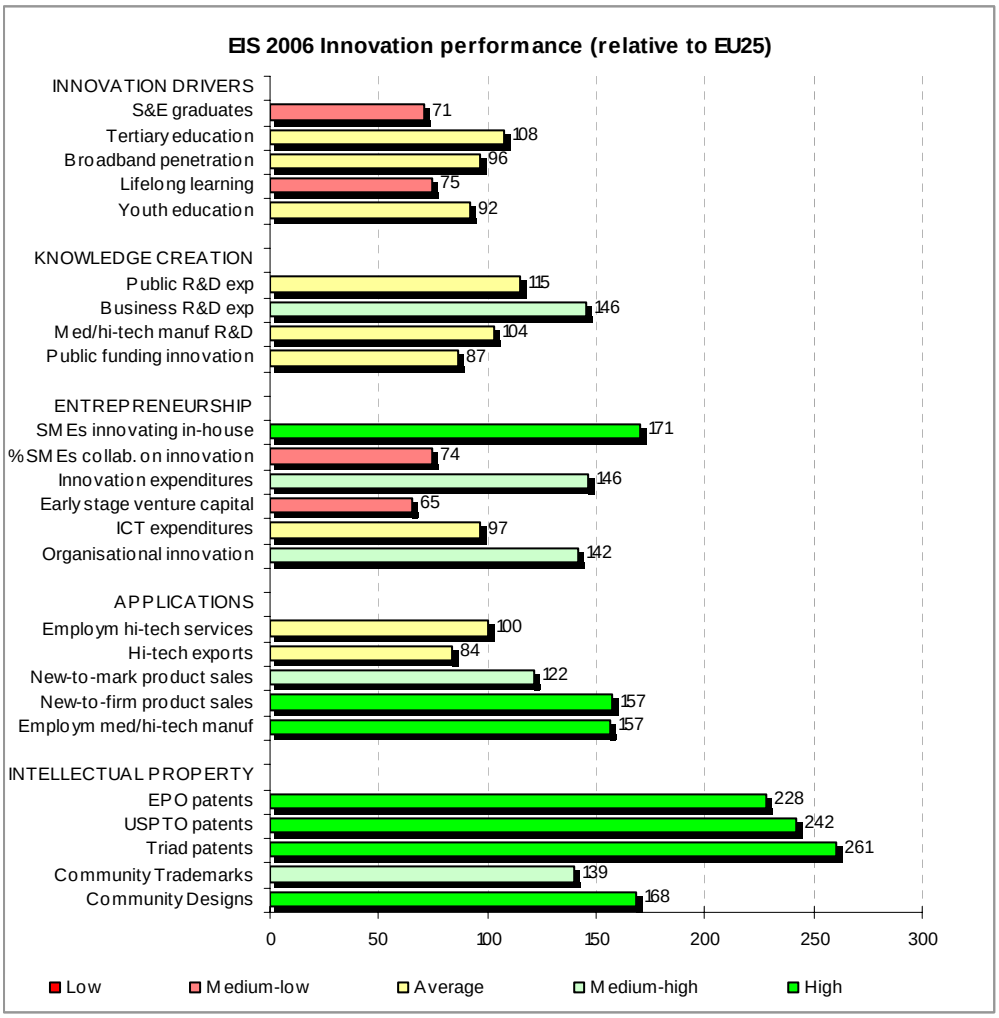
Considering the latest available data for each indicator, the situation is very positive also for Intellectual property, where all indicators are well above the EU25 average. The country shows a relative weakness in Innovation drivers (S&E graduates and lifelong learning) and in Innovation & entrepreneurship (there is a low percentage of SMEs collaborating on innovation and an undersized early stage venture capital industry).

Trend

The overall trend from 1998 to 2005 is slightly positive with indicators for participation in lifelong learning and of business R&D expenditures showing a particularly good evolution.

Population with tertiary education has improved but at a lower pace than EU25. On the other hand, the indicator for youth education attainment level has systematically decreased in absolute value since 2000. The negative trend in early stage venture capital would deserve attention.

Figure: Germany



GREECE

Overall performance

Innovation performance in Greece is well below the EU average. The less developed innovation dimension group is Intellectual property, where all indicators are very low. Broadband penetration is one of the weakest indicators, together with participation in lifelong learning, business R&D

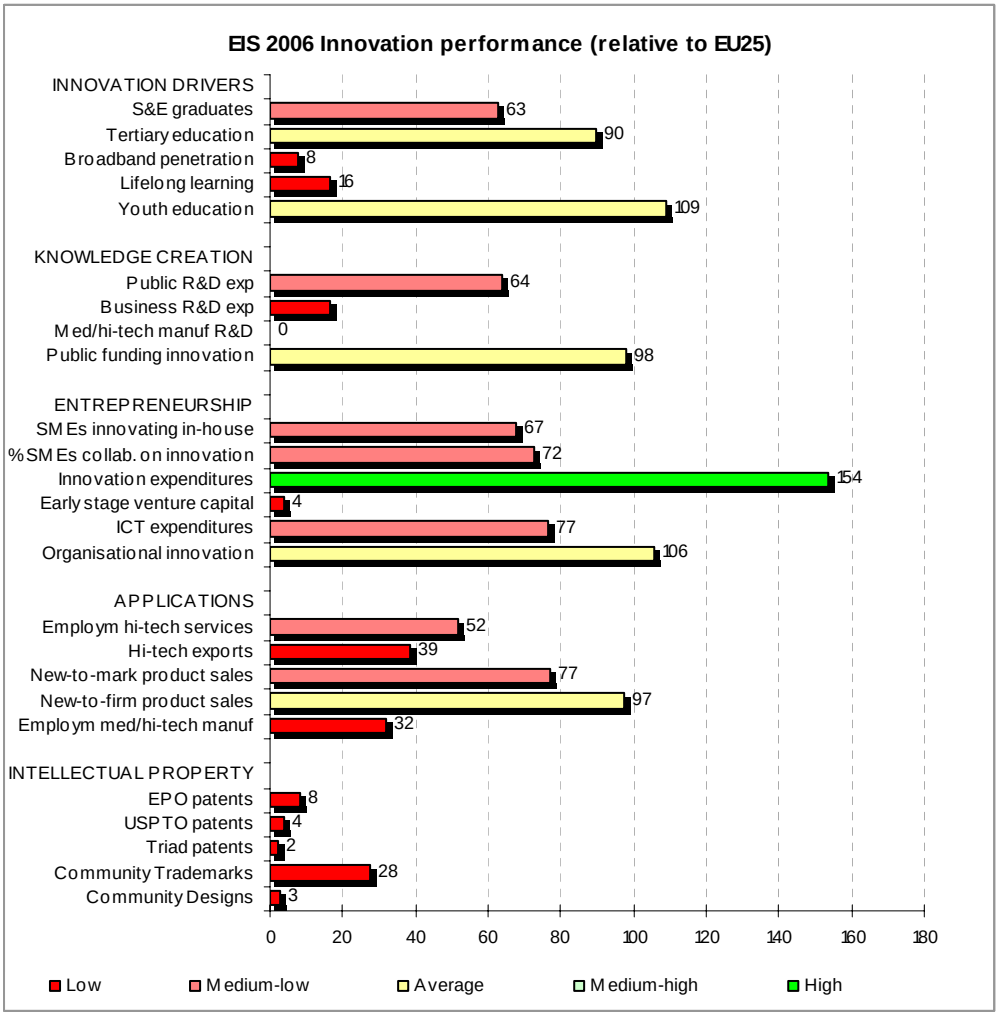
expenditures and early stage venture capital. However, there are some indicators slightly above the EU average, namely youth education attainment level, public funding for innovation and organizational innovation.

Trend

The country shows a positive trend in the innovation groups for Entrepreneurship and Applications, where most of the indicators have a positive trend. In particular, sales of new-to-market products and employment in high-tech services are increasing considerably. The indicator for youth education attainment level has grown above the EU average. The same happened in population with tertiary education.

In the group Knowledge creation, business and public R&D expenditures remain stagnant at a low level; the same problem persists for the indicators for Intellectual property.

Figure: Greece



HUNGARY

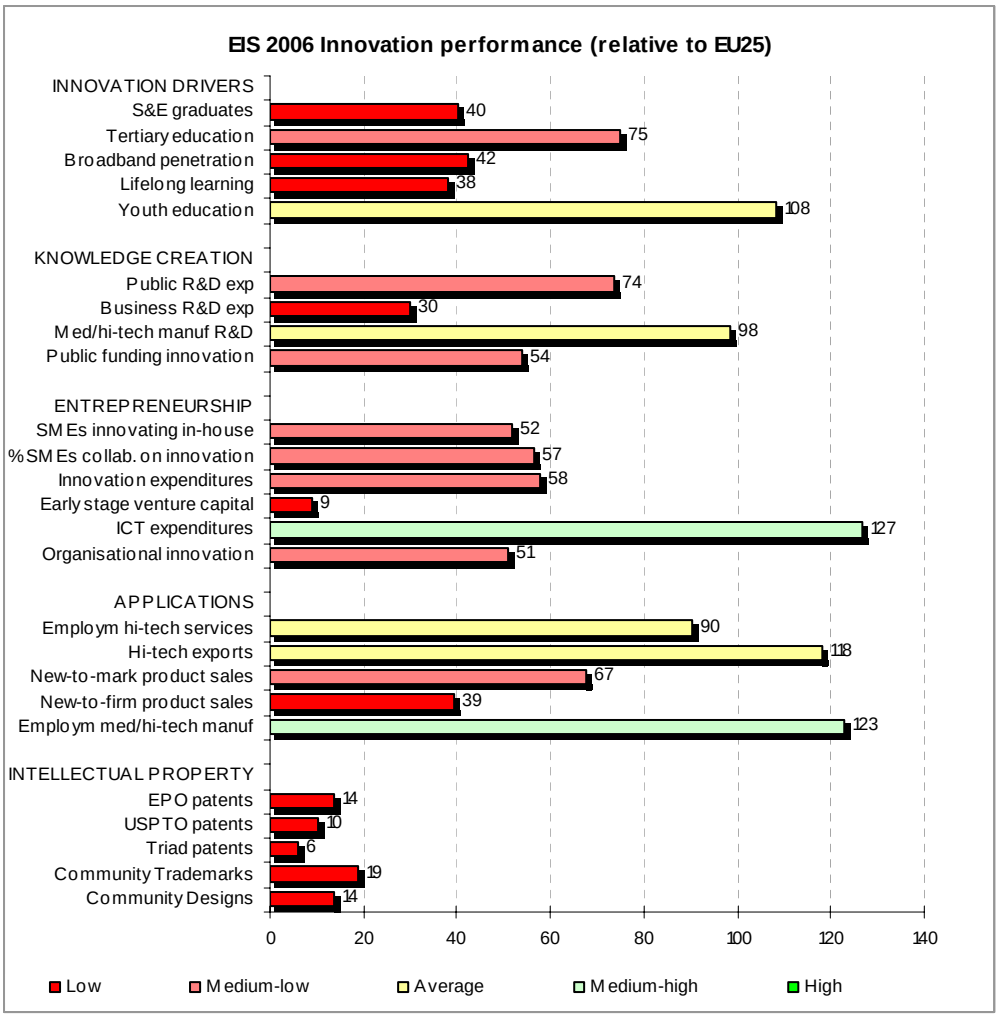
Overall performance

The innovation performance of Hungary is below the EU average. The better performing group is that of Applications, with values of employment in medium-high and high-tech manufacturing higher than the EU average since 2000. Considering the latest available data for each indicator, the best evolution appears in the export of high-tech products, ICT expenditures and youth education attainment level. On the other hand, the level of S&E graduates and participation in lifelong learning is still low. These weaknesses, together with the low level of broadband penetration, expenditures in R&D by business and the very low level of venture capital in the early stage of businesses may be hampering the overall potential for innovation.

Trend

The trend of innovation performance since 1998 is in line with the European average. Public expenditures in R&D, manufacturing in the medium/high-tech sectors and the number of US patents granted are growing above the EU average. In addition, new-to-market and new-to-firm product sales have a better trend than most of the other European countries, while triad and EPO patents are improving slightly but less than the EU average.

Figure: Hungary



ICELAND

Overall performance

The innovation performance of Iceland in 2005 is in line with the European average. Only eight indicators are available for year 2005, of which four for the group *innovation drivers*. The indicators show that Iceland is ahead on *innovation drivers* and lags behind for *applications* and *intellectual property*.

Considering the data from the latest available year, indicators in the group *innovation drivers* achieve high scores, with the exception of youth education (53% of persons aged 20-24 have completed at least their upper secondary education in 2005, against 77% of EU25) and new graduates in Science and Engineering (10.8‰ of population aged 20-29 in2004, against 12.7‰ of EU25). The group *knowledge creation* is sustained by the public and business R&D expenditures (1.17% and 1.59% of GDP in 2004, respectively).

The indicators of the group *innovation & entrepreneurship* perform well, yet the available data are quite old.

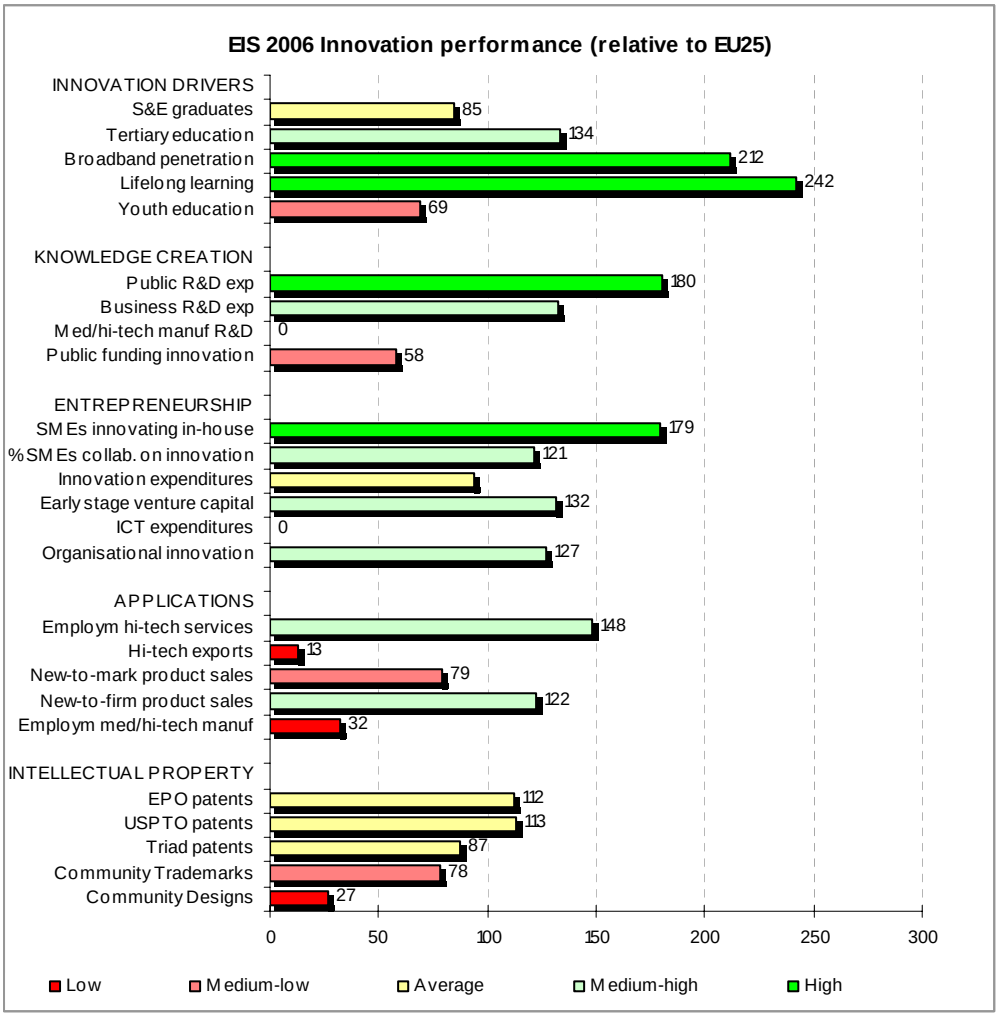
Employment in the high-tech services is high (almost 5% of total workforce in 2005– only Sweden scores better), however employment in medium-high-tech manufacturing scores well below the EU average (only 2.12% of total workforce in 2005, while EU25 scores 6.66%). Other weak indicators are exports of high-tech products (only 2.4 % of total exports for Iceland in 2004) and community trademarks and designs.

Trend

With already a good level of innovation, Iceland shows globally a positive trend for many indicators since 1998.

Only public expenditures in R&D, applications at the European patent office and patents granted by the US office are not increasing in recent years. Even if it is still weak, employment in medium-high-tech manufacturing stopped increasing in 2004.

Figure: Iceland



IRELAND

Overall performance

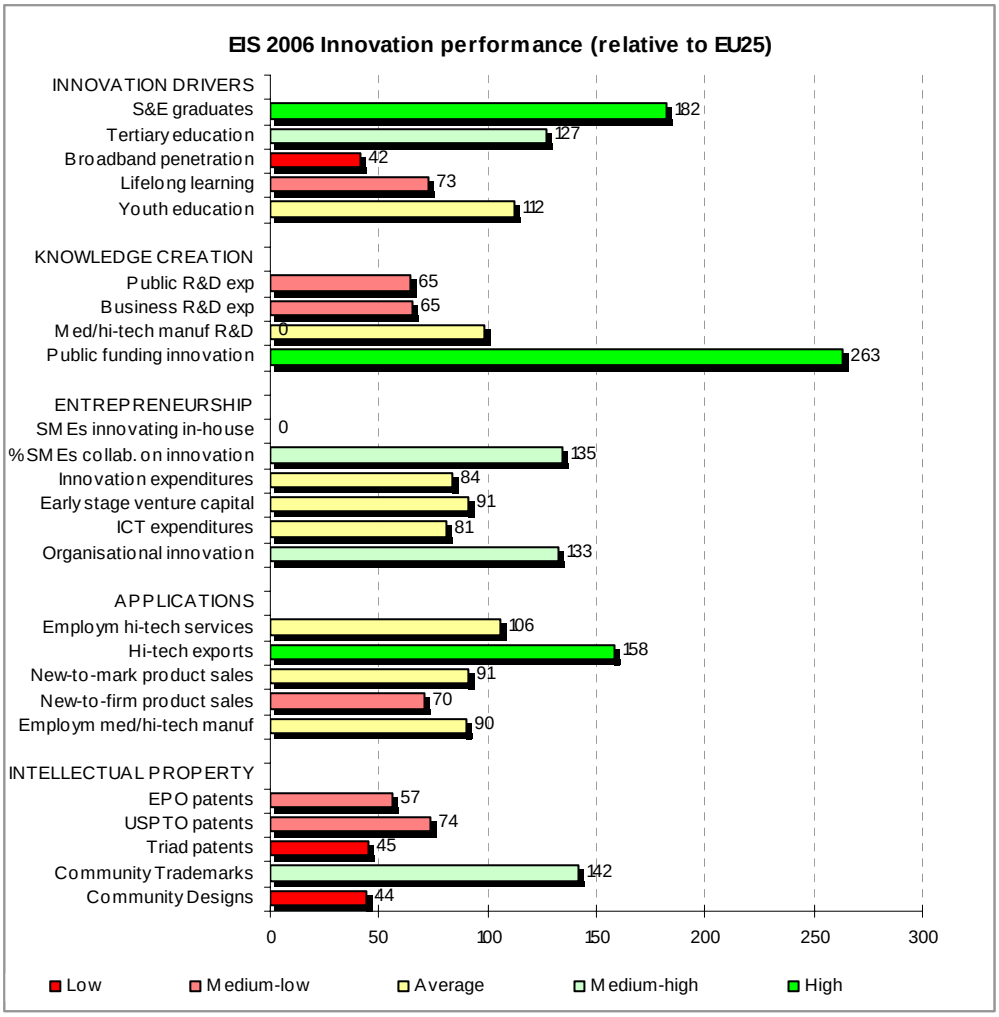
The innovation performance of Ireland is slightly above the EU average, but rather heterogeneous. The situation in innovation drivers is generally good, though broadband penetration (4.4% of broadband lines) and 8% of population participating to lifelong learning are low. The performance in intellectual properties is at the level of the EU25. The most recent available data (year 2004) indicate that the share of exports of high-tech products is almost 30% of total exports. Twelve indicators are available for 2005. The high level of youth education attainment is accompanied by high levels of S&E graduates and population with tertiary education.

Trend

The performance of the group Innovation and entrepreneurship has improved in the long term (1998-2005) as its growth rate is higher than that of the EU25. In particular, innovation expenditures have increased considerably. However, the indicators in the group Applications are declining: exports of high-technology have declined considerably from 39% of total exports in 1999 to 29% in 2004; and employment in high-tech services has slightly reduced (from 4% of total workforce in 2000 to 3.5% in 2005).

In addition, broadband penetration in Ireland has improved less than the EU average since 2004 (form 1.7% to 4.4% in Ireland, from 6.5% to 10.6% in Europe).

Figure: Ireland



ITALY

Overall performance

Italy's innovation performance is somewhat below the EU average. However, recent indicators are missing especially in the group of knowledge creation and Innovation & entrepreneurship. The indicators in the group innovation drivers are below the EU average. In particular, population with tertiary education (12% of population aged 25-64) is much lower than the European average (23%). Amongst input indicators, a significant score is obtained for the share of enterprises that receive public funding for innovation (14% of enterprises). Considering output indicators, new community industrial design is doing particularly well, while a relatively weaker performance is achieved for patents applications and patents granted. Attention should be given to the situation of early stage venture capital and innovative SMEs should be encouraged to cooperate with others.

Trend

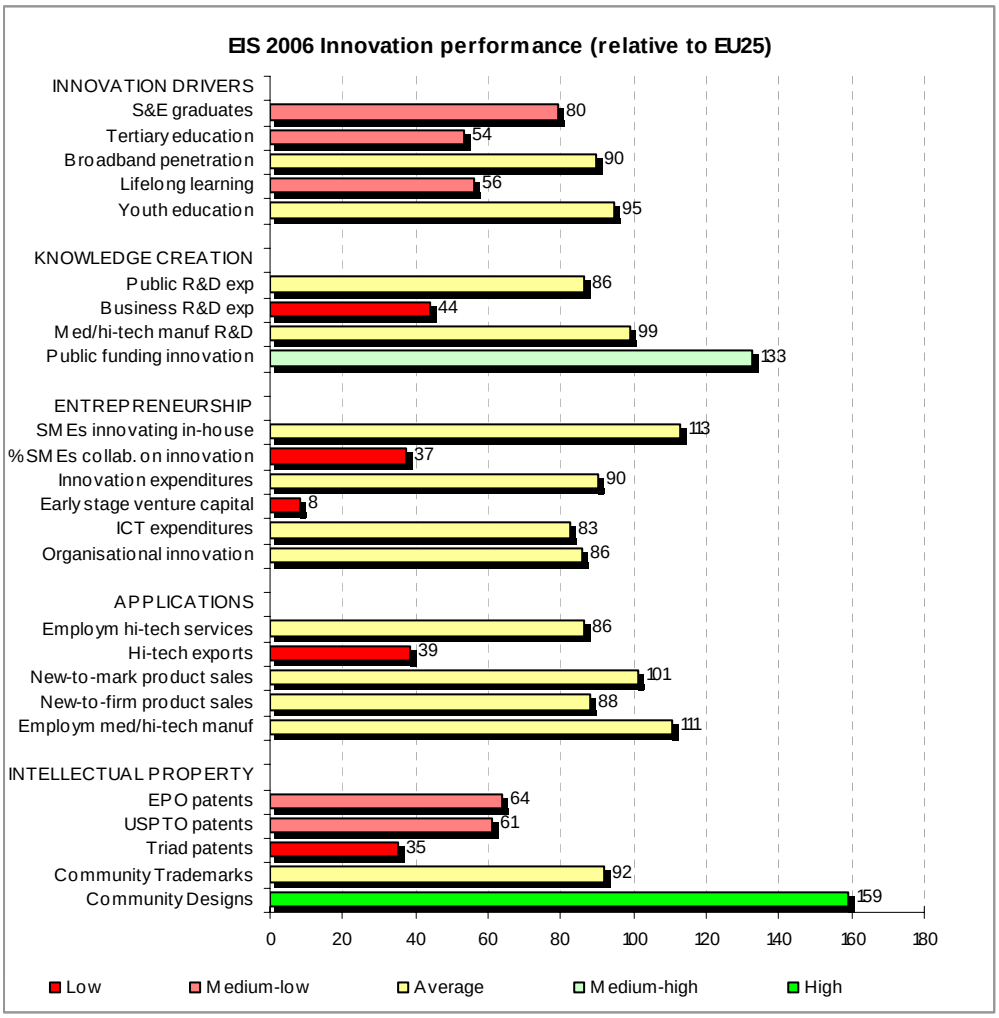
Italy shows a positive trend over the period 1998 – 2005. The main progress is achieved in the number of new graduates in science and engineering, which almost doubles in the period 2000 – 2004. No improvement has taken place in the number of US patents in the period 1998 – 2003, although the same holds for the EU itself in the same period.

ICT expenditures increased in the period 2000 – 2005, while they remained constant at European level.

There is no convergence with the EU25 in new community trademarks, early stage venture capital, triad patents and employment in high-tech services (the latter has decreased from 3.1% to 2.9%). These indicators point to possible bottlenecks to improve the innovation performance of the country.

In the short-time, from 2004 to 2005, the indicators displaying the best evolution are new community industrial designs, broadband penetration (+3.4%), population with tertiary education (+0.6%) and business expenditures in R&D (+0.02%), though they are under the evolution of the EU average.

Figure: Italy



JAPAN

Overall performance

Japan's innovation performance is strong, although with a heterogeneous behaviour in the group *intellectual property*, where USPTO patent grants and triad patents achieve very high scores (304.6 and 102 per million population in 2003 respectively), while new Community trademarks (11.7 per

million population against 88 for EU25 in 2005) and new Community designs (13.2 per million population against 111 for EU25 in 2005) are practically insignificant. However, there are no available data for 2005.

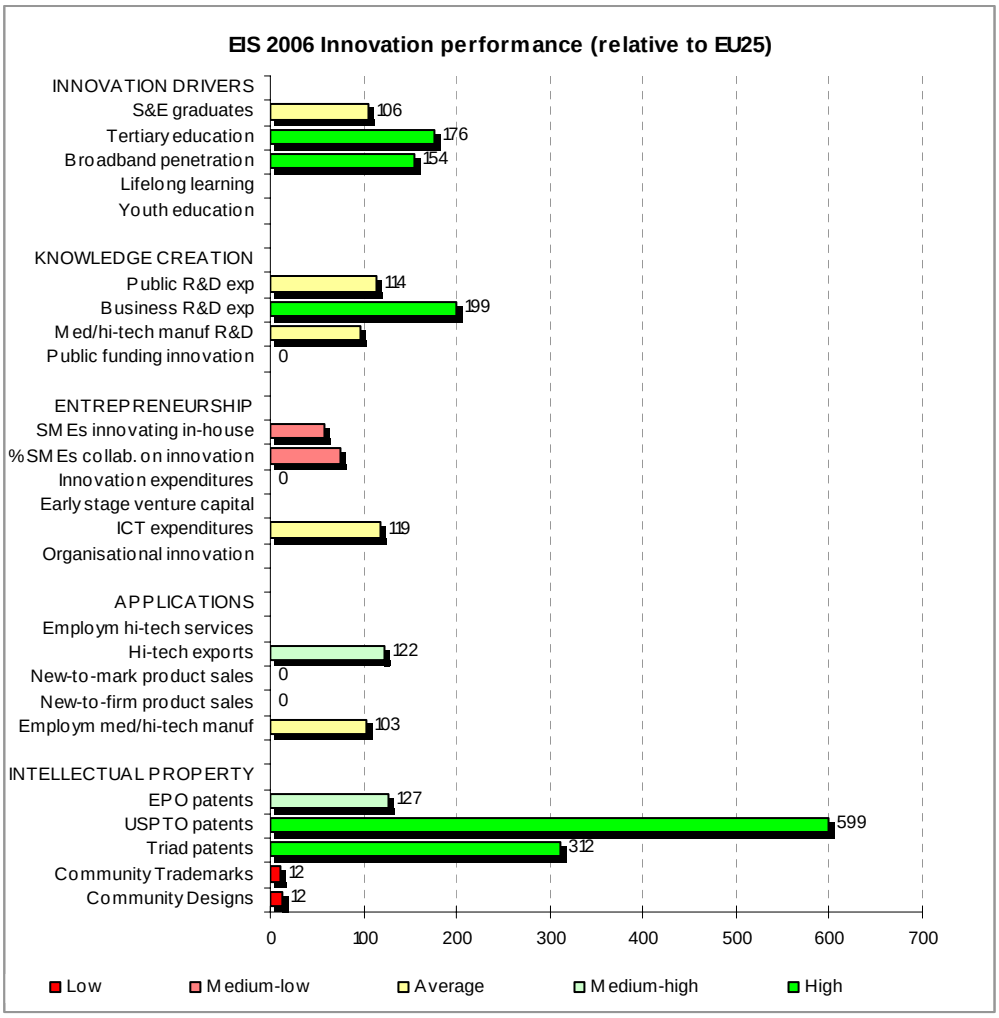
Other strengths of the country are population with tertiary education (37.4% in 2003 against 21.3% for EU25), broadband penetration (16.3% in 2005 against 10.6% for EU25) and business R&D expenditures (2.4% of GDP in 2004 against 1.2% for EU25). In addition, ICT expenditures in 2005 have reached 7.6% of GDP (against 6.4% for EU25). Japan applies for more patents at the European patent office than EU25 countries (174.2 per million populations against 136.7, data of 2003).

Trend

The trend for Japan is positive for the group *intellectual properties*, as all patents are strongly increasing (the opposite occurs for community trademarks and designs).

Other indicators increasing during the time considered are population with tertiary education, broadband penetration rate, business R&D expenditures, and share of medium-high tech manufacturing R&D. Remarkable is also the strong increase of ICT expenditures as share of GDP: 5.2% in 2000, 7.6% in 2005, as compared to 6.5% and 6.4% for the EU25 in the same years. A negative trend occurred in exports of high technology and employment in medium-high tech manufacturing.

Figure: Japan



LATVIA

Overall performance

Latvia's innovation performance is well below the EU average. There are ten indicators available for Latvia for year 2005. All of them are below the EU-25 average, with the only exception of youth education attainment level, with almost 82% of young population having completed at least the upper secondary education.

Considering the latest available data for each indicator, the amount of ICT expenditures is above EU25. Other indicators displaying a positive evolution include innovation expenditures (1.4% of turnover in 2002) and population with tertiary education (20.5% of population in 2005; EU25 is almost 23%), followed by the share of R&D expenditures in the medium/high-tech sector (78% of R&D expenditures in all sectors) and in small and medium enterprises that introduced organizational innovation (35.7% of all SMEs, in 2000).

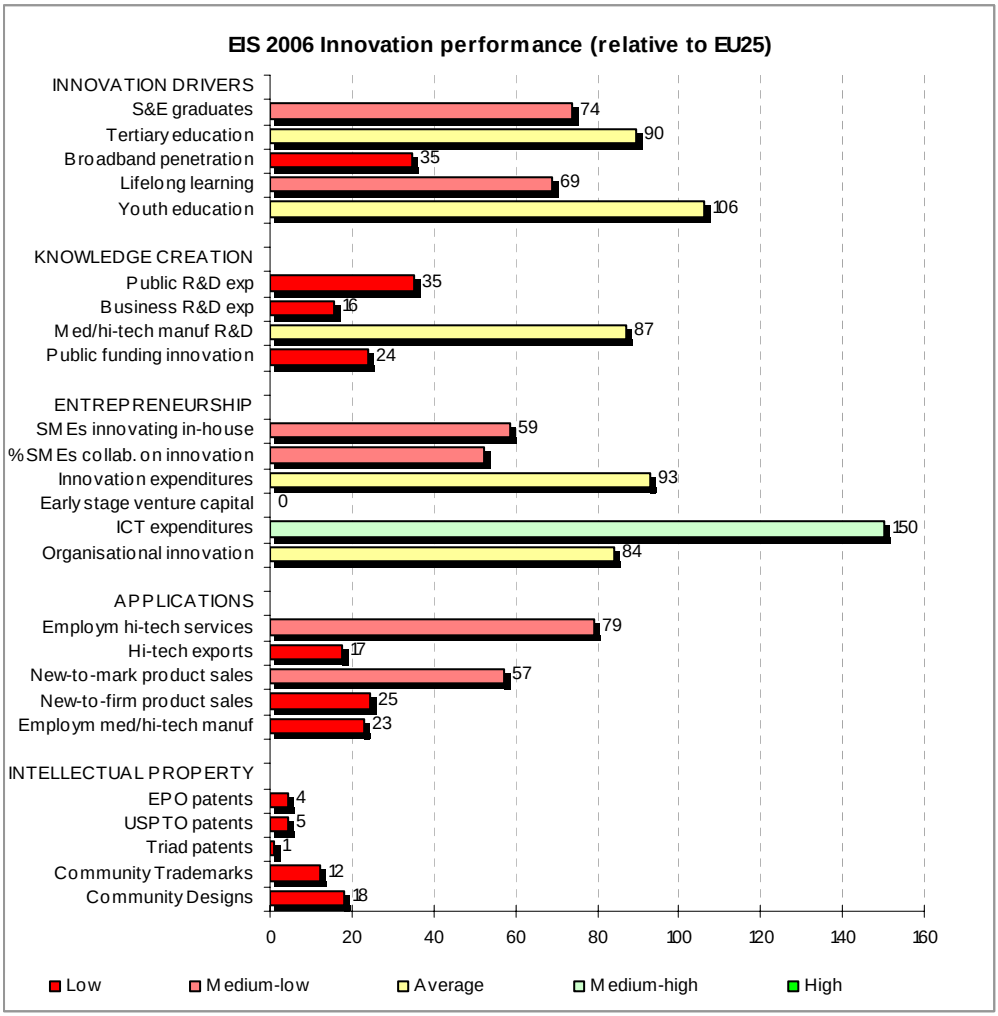
All the other indicators reveal relative weaknesses in the national innovation system. In particular, the entire group for Intellectual property, R&D expenditures in the public (0.34% of GDP) and business (0.23% of GDP) sectors, and the high-tech exports (3.2% of GDP) show scope for improvement.

Trend

Latvia has experienced some positive trends in recent years. In the group of Innovation drivers, Latvia has the highest trend for the level of youth education attainment (from 73% of young population in 2002 to 82% in 2005): yet, there has been a deterioration in participation of population to lifelong learning (from 8.2% of total population in 2002 to 7.6% in 2005), while new S&E graduated showed a moderate growth, in line with that of EU25 average.

There was progress in almost all indicators of the group Applications. In particular, employment in high-tech services grew from 2.2% of total workforce in 2001 to 2.7% in 2005. Also business R&D expenditures showed quite a significant growth (from 0.09% of GDP in 1998 to 0.23% in 2005), although its level is still low.

Figure: Latvia



LITHUANIA

Overall performance

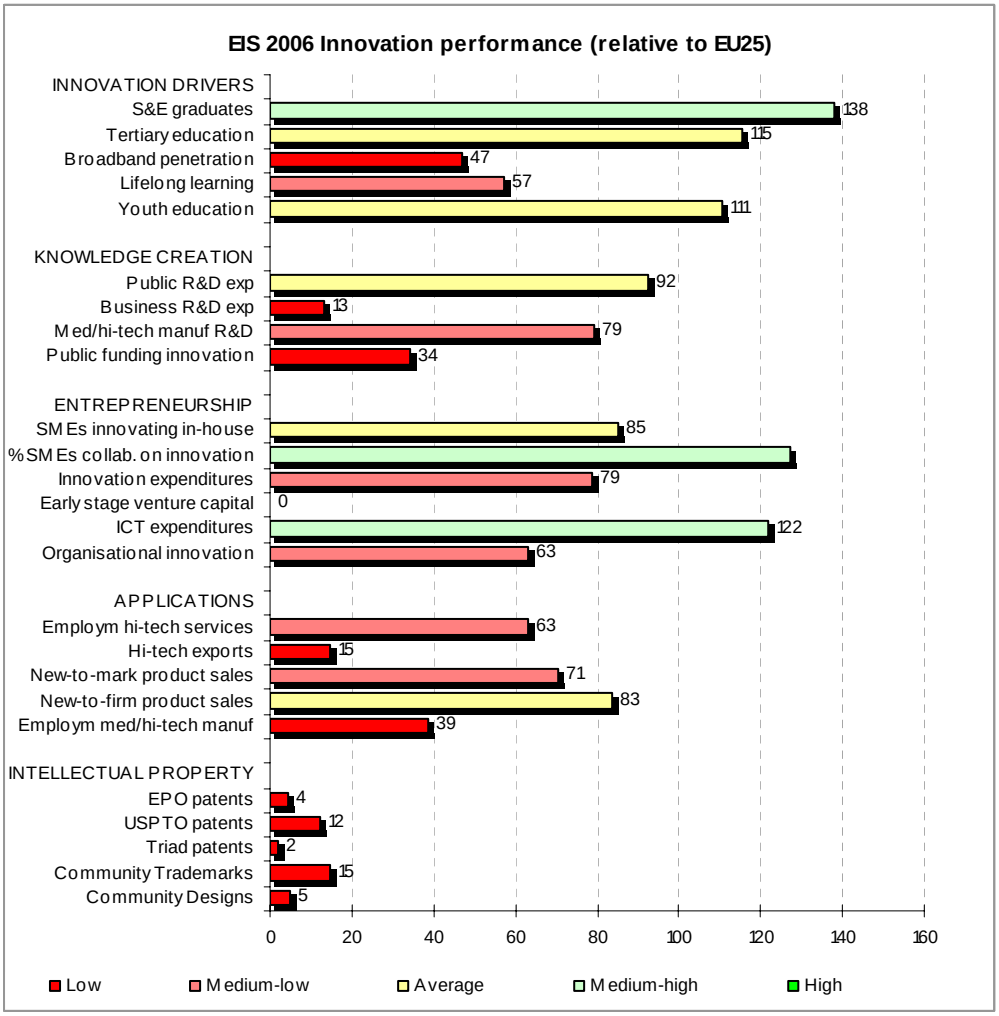
Lithuania's innovation performance is well below the EU average and presents a rather heterogeneous behaviour. From most recent available data a positive performance can be found in the level of youth education attainment (85.2% of young population has completed at least upper secondary education; the European average is 77%). Considering the latest available data for each indicator, some positive evolution appears, in particular in the group for Innovation drivers: the number of S&E graduates (17.5% of population aged 20-29; against 12.7% of European average), population with tertiary education and, again, youth education attainment. In line with the EU25 level are also the percentage of innovative SMEs collaborating with others (15% in 2004) and ICT expenditures. Performance in innovation output can be improved: in the group Applications, exports of high-technology are only

2.7% of total exports (EU25 is 18.4%, data of 2004), and all indicators in the group Intellectual property are well below the European average.

Trend

Lithuania's trend in the period 1998 – 2005 is positive for several indicators. Efforts have been taken to improve cooperation between SMEs on innovation, to increase employment in high-tech services, sales of new-to-market products and US patents. In the short period 2003 – 2004 public R&D expenditures increased considerably (the best performance across Europe) and new community trademarks showed a sharp increase (though the levels are still very far from Europe). On the other hand, participation of population in lifelong learning diminished, thus increasing the gap with Europe.

Figure: Lithuania



LUXEMBOURG

Overall performance

The innovation performance of Luxembourg is above the EU average, but heterogeneous with some indicators at very high levels and others showing weaknesses. Of the ten innovation indicators available for year 2005 Intellectual property is a strong group: Luxembourg leads in new community trademarks and industrial designs (783 trademarks and 377 designs per million populations in 2005). Considering the latest available data for each indicator, Luxembourg has the highest share of enterprises receiving public funding for innovation (39% in 2004), and the role of SMEs in promoting innovation is noteworthy.

The weakest indicators are the number of graduates in Science and Engineering (only 1.8 per thousand population aged 20-29, 2000 data), public R&D expenditures (only 0.21% of GDP, 2005 data), and employment in medium-high-tech manufacturing (1.4% of the total workforce, 2005 data).

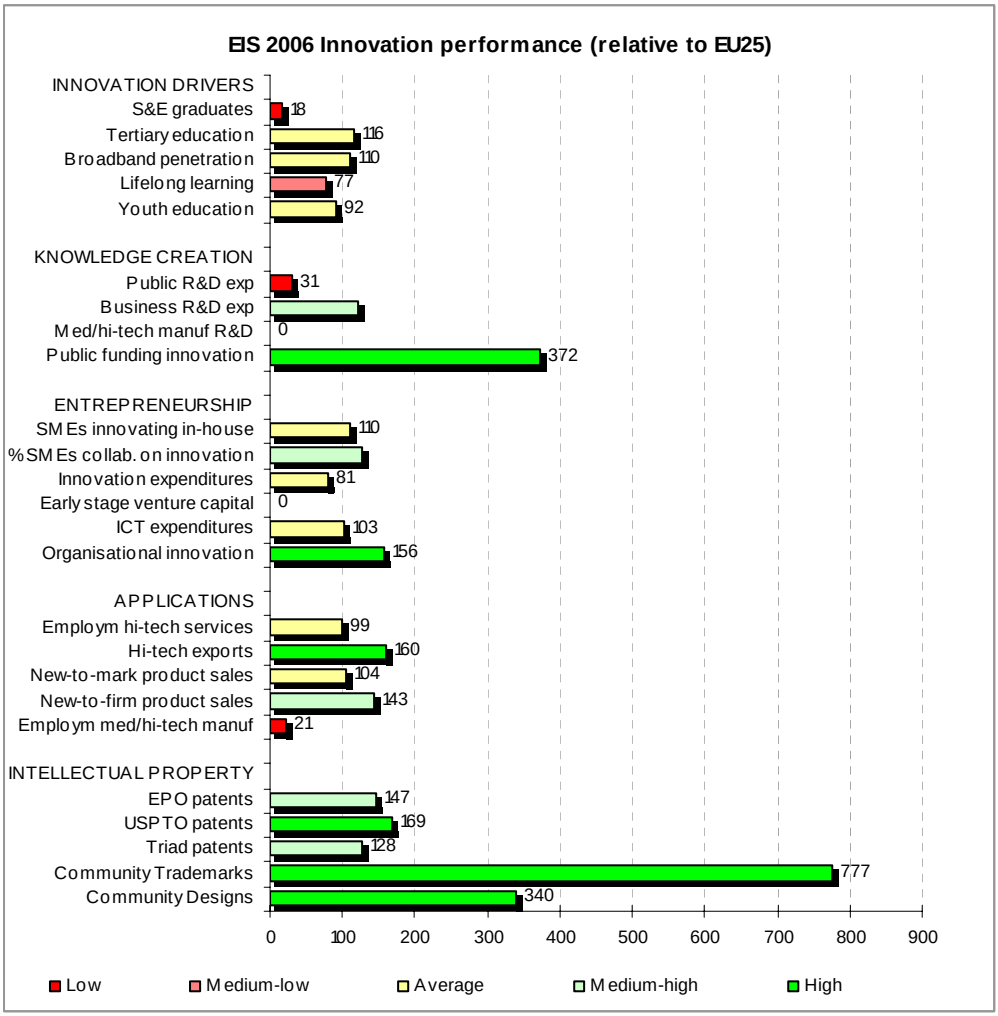
Trend

Luxembourg's trend is positive in the group Applications, where all its indicators have improved their performance. This was specially the case for employment in high-tech services and for exports of high-technology, where most other European countries did not make progress.

Positive trends are represented by the share of enterprises receiving public funding for innovation (from 7% in 2000 to 39% in 2004), population with tertiary education (from 18.5% of active population in 2000 to 26.6% in 2005) and new community trademarks (from 574 per million populations in 2001 to 783 in 2005).

Business expenditures in R&D and triad patents decreased in the last five years, while in most European countries the trend was the opposite.

Figure: Luxembourg



MALTA

Overall performance

Malta's innovation performance is below the EU average. Of the nine indicators available for the year 2005, Malta's innovation performance is comparable to the EU-25 average only for the group Applications. For the other groups (except for entrepreneurship, for which no data are available) the performance is weaker.

Considering the latest available data for each indicator, applications is the best performing group, with the highest levels for high-tech exports (56% of exports are high-tech, 2004 data) and for sales of new-to-market products (13.6% of total turnover, 2004 data).

Indicators about new to firm product sales and ICT expenditures (8.7% and 8.5% respectively in 2004) are also above the EU25 average.

The weakest performances are for patents and community designs, followed by business R&D expenditures and SMEs innovating in house.

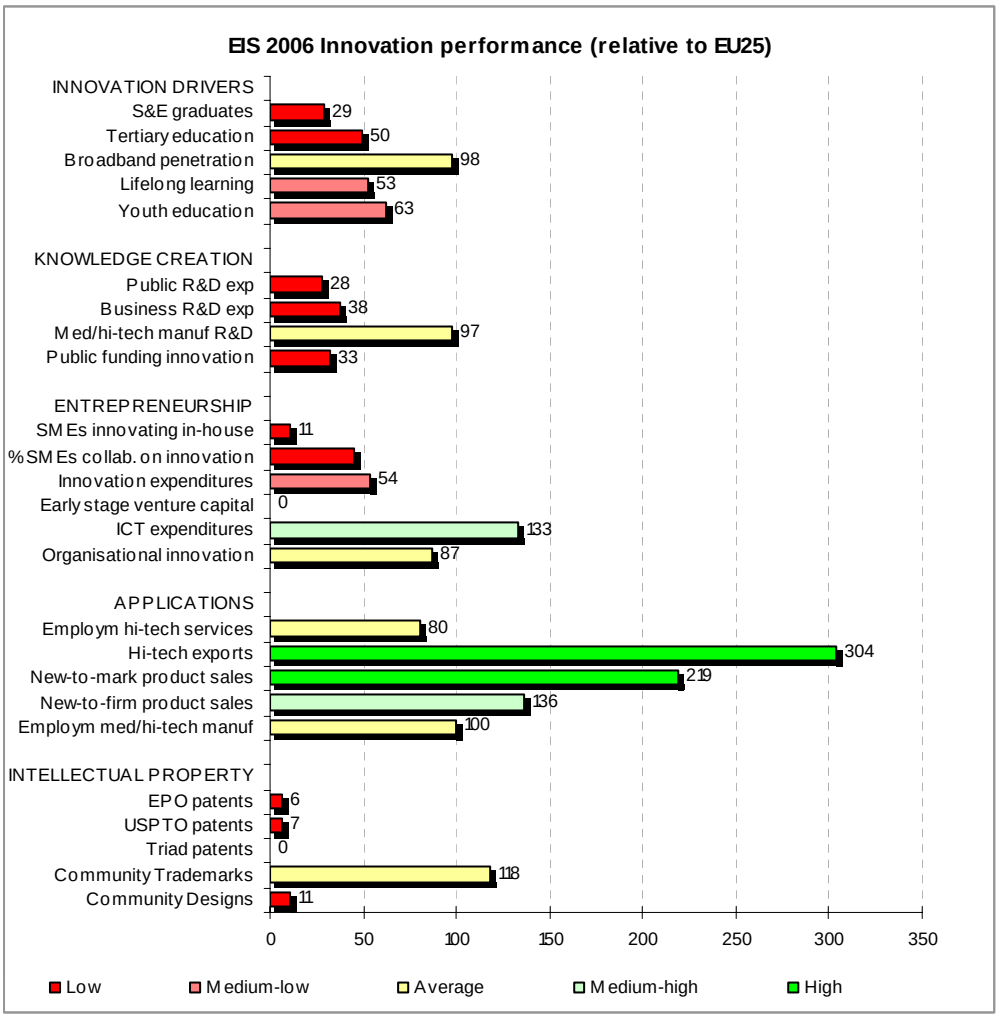
Trend

The trend for the country has been positive for a number of indicators, in particular medium-high tech manufacturing R&D, organizational innovation, sales of new to market and new to firm products.

The level of S&E graduates and lifelong learning is still low, even if they started to improve in 2002 and 2004 respectively; tertiary education is weaker, as it fluctuates and stopped growing after 2003.

The level of business R&D expenditure is very low, but the trend is very positive over time (from 0.07% to 0.45% in three years).

Figure: Malta



NETHERLANDS

Overall performance

Netherlands's innovation performance is above the EU average. It is particularly good in Innovation drivers and Intellectual property, while the Innovation & entrepreneurship and Applications groups may be revealing some weaknesses in the innovation system. Of the ten indicators available for the year 2005 broadband penetration rate (22%, while EU25 has 10.6%), ICT expenditures (7.6% of GDP versus 6.4% in EU25) and employment in high tech services (4%, slightly higher than EU25) show the best performance. Other strong indicators include lifelong learning participation and patents.

Some weaknesses in the Dutch innovation system may lie in early stage venture capital (0.005% versus 0.023% in EU25) and in employment in medium-high tech manufacturing (3.3%, which is half the percentage of EU25).

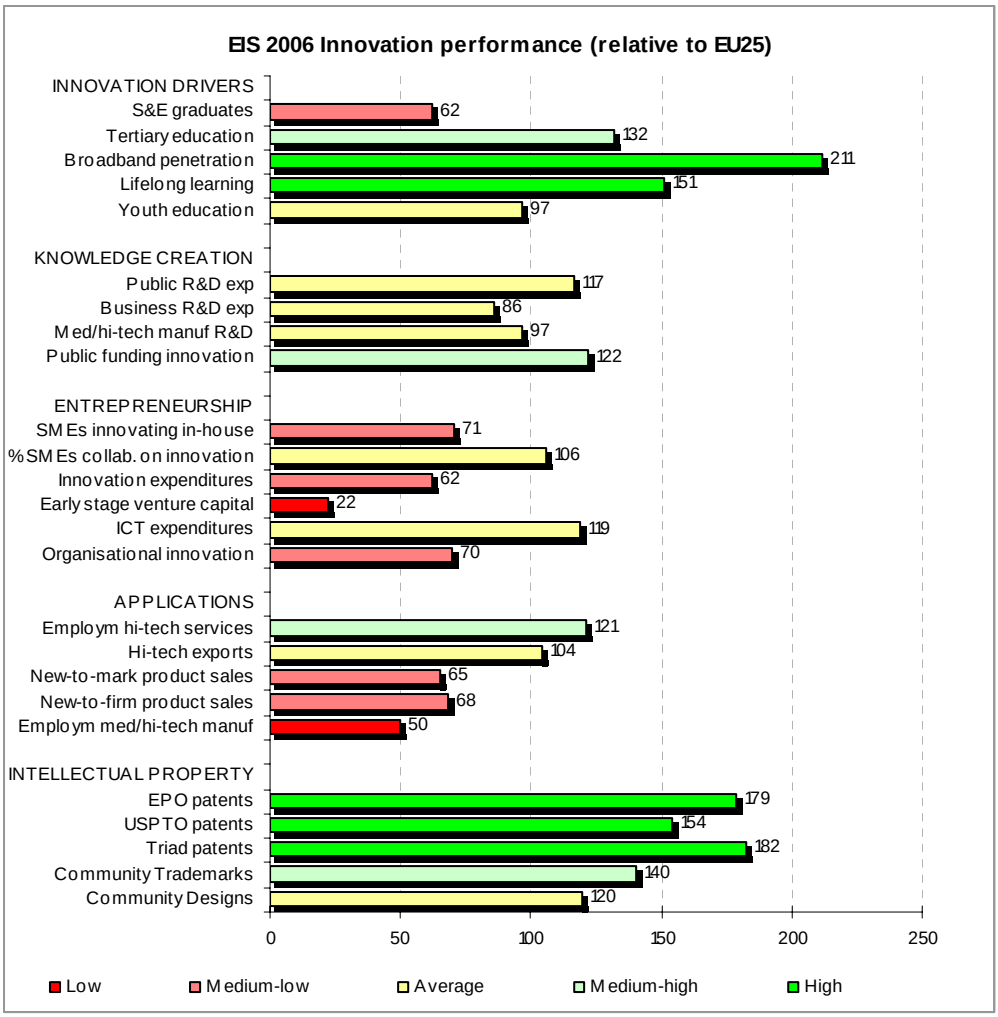
Trend

On the whole, the trend of the country is positive. In particular, S&E graduates (from 5.8 per 1000 population aged 20-29 in 2000 to 7.9 in 2004) and youth education attainment level, which are lagging behind slightly with respect to other innovation drivers, are growing over time.

On the other hand, business R&D expenditures remain stagnant, while public expenditures are growing only from 2003.

The weakest indicator is early stage venture capital, which doesn’t show any positive evolution over the timeframe considered.

Figure: Netherlands


EIS 2006 Innovation performance (relative to EU25)
INNOVATION DRIVERS
S&E graduates
62
Tertiary education
132
Broadband penetration
211
Lifelong learning
151
Youth education
97
KNOWLEDGE CREATION
Public R&D exp
117
Business R&D exp
86
Med/hi-tech manuf R&D
97
Public funding innovation
122
ENTREPRENEURSHIP
SMEs innovating in-house
71
%SMEs collab. on innovation
106
Innovation expenditures
62
Early stage venture capital
22
ICT expenditures
119
Organisational innovation
70
APPLICATIONS
Employm hi-tech services
121
Hi-tech exports
104
New-to-mark product sales
65
New-to-firm product sales
68
Employm med/hi-tech manuf
50
INTELLECTUAL PROPERTY
EPO patents
179
USPTO patents
154
Triad patents
182
Community Trademarks
140
Community Designs
120
0
50
100
150
200
250
Low
Medium-low
Average
Medium-high
High

NORWAY

Overall performance

Norway's innovation performance is particularly strong for *innovation drivers*, while the output groups are still at lower levels compared to the EU-25. For 2005 Norway is missing data for 13 indicators; the figure shows the complete picture using most recently available data.

Broadband penetration (18.4% in 2005, while EU25 has 10.6%) and lifelong learning (19.4% I 2005 versus 11% for EU25) are the strongest indicators in Norway, followed by public funding for innovation. Also tertiary and youth education are above the EU25 average, while S&E graduates are still at a low level (9‰ in 2004 while EU25 is at 12.79‰).

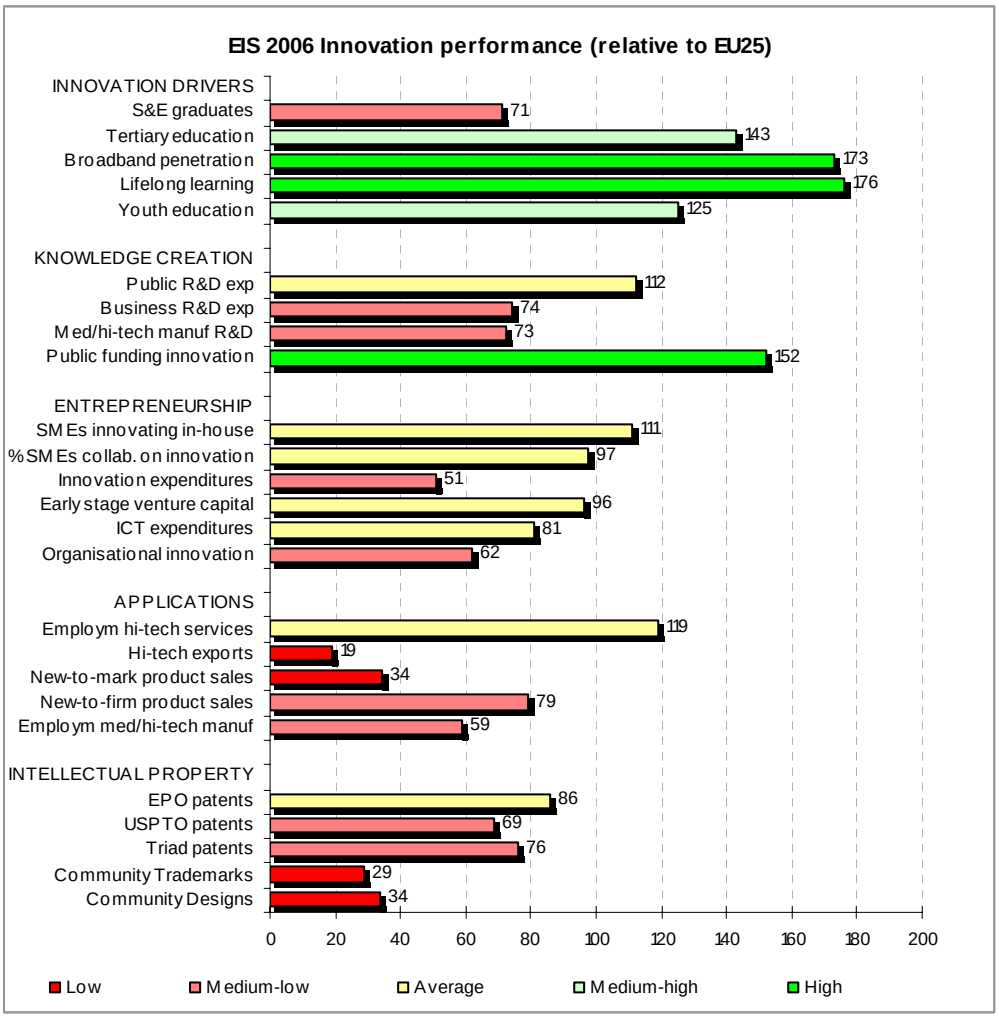
The weakest indicators are represented by high tech exports, new to market product sales and community trademarks and designs.

Trend

Business R&D expenditures are below average and presenting a slightly negative trend (from 0.99% in 2003 to 0.82% in 2005), while some positive trend is present for S&E graduates (from 7.9‰ in 2000 to 9‰ in 2004).

In most recent years (2003-2005) also employment in high tech services showed a certain improvement, while early stage venture capital started to decrease.

Figure: Norway



POLAND

Overall performance

Poland's innovation performance is well below the EU average. Only youth education level results are above the EU25 average (90% in Poland versus 77% in EU25).

Considering the latest available data for each indicator, new to market product sales are considerably higher than the EU average (8%, while EU25 has 6.2%), as well as new to firm sales. Furthermore, the country shows quite a high score for ICT expenditures and medium and high tech manufacture R&D.

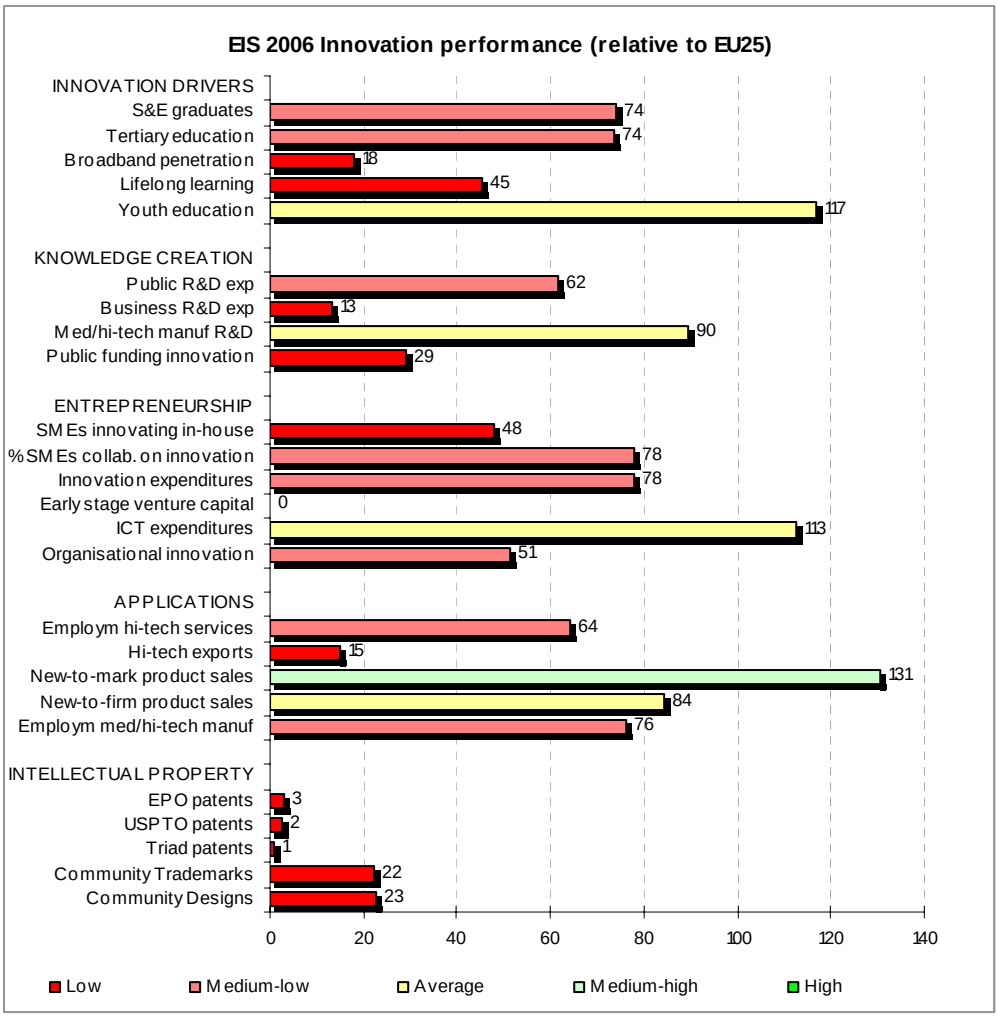
The weakest group of indicators for Poland is Intellectual property, where all indicators are very low (e.g. new EPO patents is at 4.2‰ in 2003, while EU25 has 136.7‰ in the same year). Areas such as high-tech exports, Business R&D expenditures and broadband penetration display scope for improvement.

Trend

The country experienced some positive trend in various indicators. From 1998 to 2005, indicators such as S&E graduates (from 6.6‰ in 2000 to 9.4‰ in 2004), youth education, ICT expenditures, innovative SMEs (doubled from 2000 to 2004) and new UPSTO patents grew significantly.

In more recent years (from 2002) also business R&D and population with tertiary education have had an important improvement. Other indicators are still stagnant at low level, like public R&D expenditures and new community trademarks.

Figure: Poland



PORTUGAL

Overall performance

Portugal's innovation performance is below the EU average. All 12 available indicators for 2005 are below the EU25 average. Considering the latest available data for each indicator, early stage venture capital (0.033%, while EU25 has 0.023%), followed by ICT expenditures (7.4% in Portugal while 6.4% in EU25) and SMEs using organizational innovation (40.7% versus 37.4% in EU25) are above the EU average.

The weakest performance comes from the indicators in the intellectual property group, although also the indicators for lifelong learning, business R&D and high tech exports are below the EU-25 average.

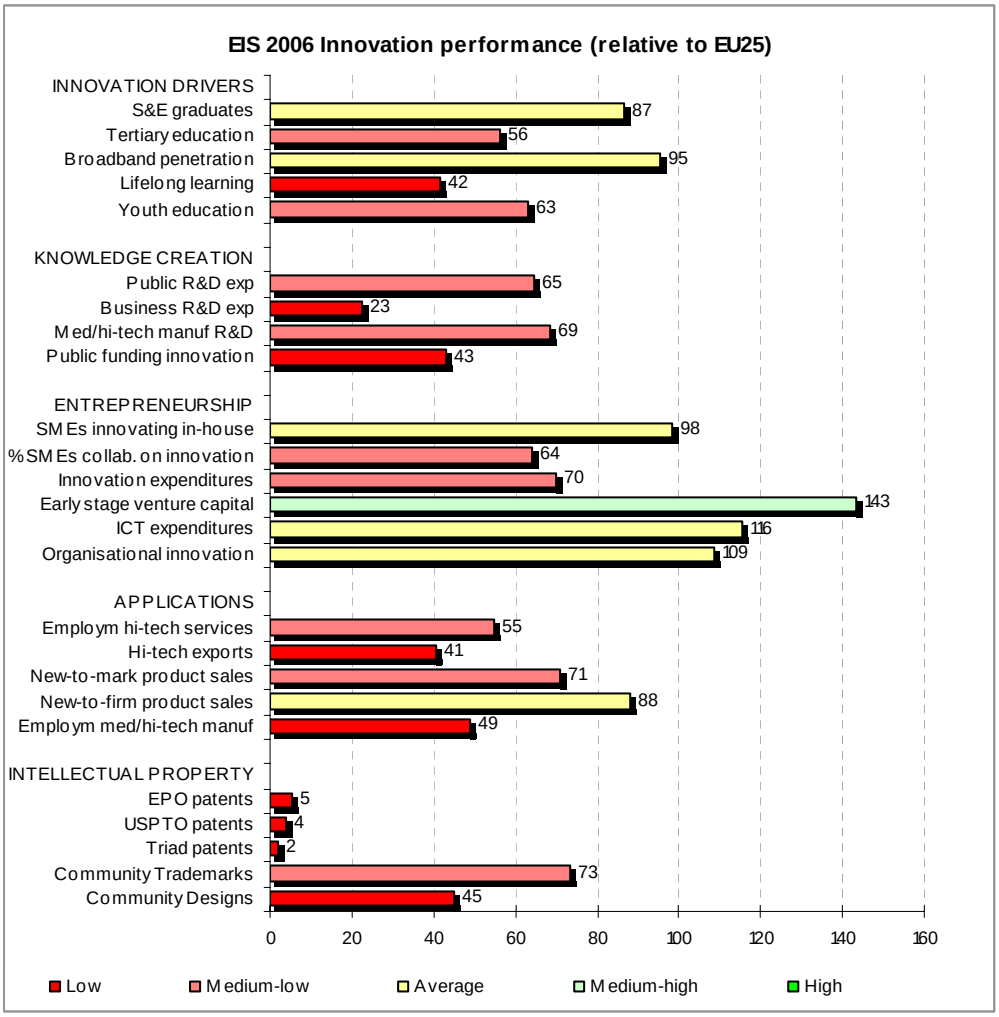
Trend

A number of positive trends took place from 1998 to 2005, especially in Innovation drivers and Innovation & entrepreneurship. S&E graduates (from 6.3‰ in 2000 to 11‰ in 2004) and youth education increased significantly (from 40.1% in 1999 to 48.4% in 2005), and the same happened for ICT expenditures and early stage venture capital.

On the other hand, the entire Knowledge creation group (including business R&D expenditures) did not experience much progress. The group of indicators for intellectual property was also stagnant, with the only exception of USPTO patents (from 1.3 in 1999 to 1.9 in 2003 per million populations).

Over a short period of time, a positive trend took place in employment in high tech services, exports of high tech and employment in medium-high tech manufacturing.

Figure: Portugal



ROMANIA

Overall performance

Innovation performance in Romania is well below the EU average. Strengths in the Romanian innovation system concern new to firm product sales (9.5% in 2004, while EU25 has 6.4%), immediately followed by new to market product sales and employment in medium-high tech manufacturing (accordingly, also medium-high tech manufacturing R&D is quite high).

The indicators for intellectual property are low; as well as several other indicators from other groups, such as lifelong learning (1.6% in Romania versus 11% in EU25 for 2005) and business R&D expenditures (0.21% in 2004 versus 1.2% in EU25). Early stage venture capital is practically absent.

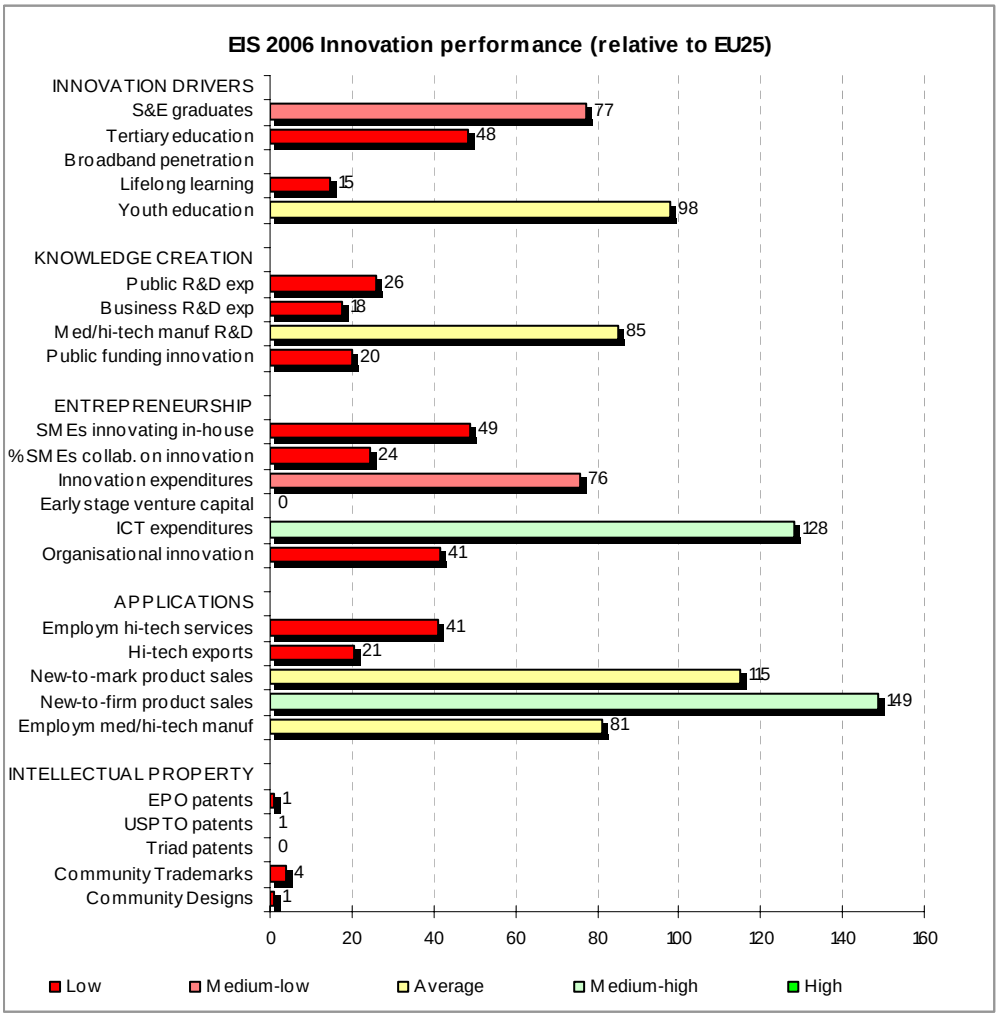
Trend

The indicators characterized by a positive trend from 1998 to 2005 are in particular S&E graduates (from 4.5‰ in 2000 to 9.8‰ in 2004) and sales of new to firm products (1.6% in 2000 and 9.5% in 2004); also public R&D expenditures and innovation expenditures have been increasing slightly.

Business R&D expenditures did not improve, and the same happened for new EPO patents and new community trademarks.

SMEs did not seem to show a significant improvement in innovating in house and in collaborating on innovation.

Figure: Romania



SLOVAKIA

Overall performance

The innovation performance of Slovakia is well below the EU average. Some important indicators are performing well (if we consider data for 2005 and previous years) new to market product sales (12.8% in 2004) and employment in medium-high tech manufacturing (9.37% in 2005) are reaching high scores (EU25 has 6.2% and 6.66% respectively).

Also indicators such as youth education, innovation and ICT expenditures and employment in high tech sectors are in line with the EU25 average.

On the other hand, indicators such as broadband penetration, business R&D expenditures and early stage venture capital are weak. Intellectual property is the less developed group, while indicators in Applications are the best performing ones. This reveals a rather heterogeneous behaviour of Slovakia's innovation system.

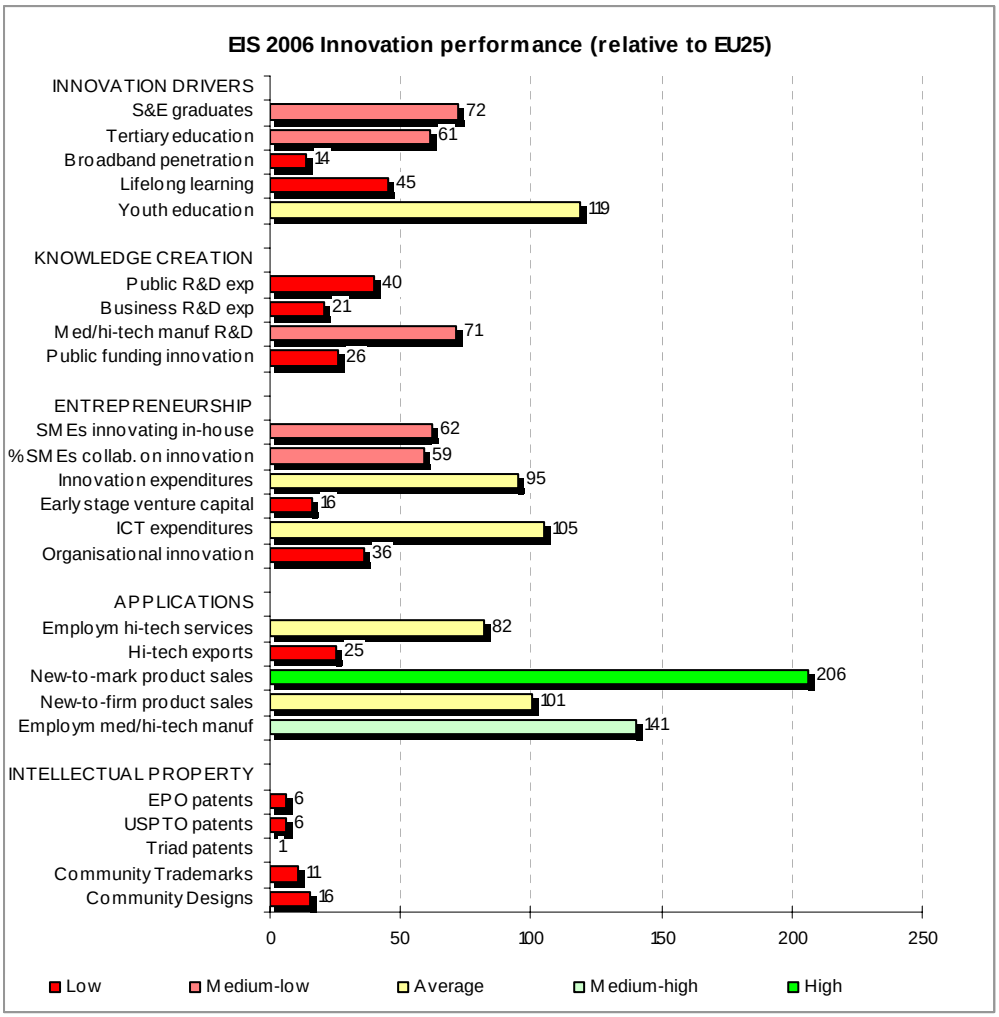
Trend

The majority of positive trends are taking place in the Innovation & entrepreneurship and Applications groups (the strongest indicators are also the ones with positive trend).

Business R&D expenditures are decreasing, while some slight fluctuation is taking place in public R&D.

Referring to Innovation drivers, the situation is stationary for tertiary education and youth attainment level, while a positive trend has taken place for S&E graduates (from 5.3‰ in 2000 to 9.2‰ in 2004).

Figure: Slovakia



SLOVENIA

Overall performance

The innovation performance of Slovenia is slightly below the EU average. The majority of indicators for Slovenia are around the EU25 average, with exception of those in the intellectual property group, which are below it. The best performing indicators are lifelong learning participation (17.8%, versus 11% in EU25) and employment in medium-high tech manufacturing (9.63% in 2005, versus 6.66% in EU25).

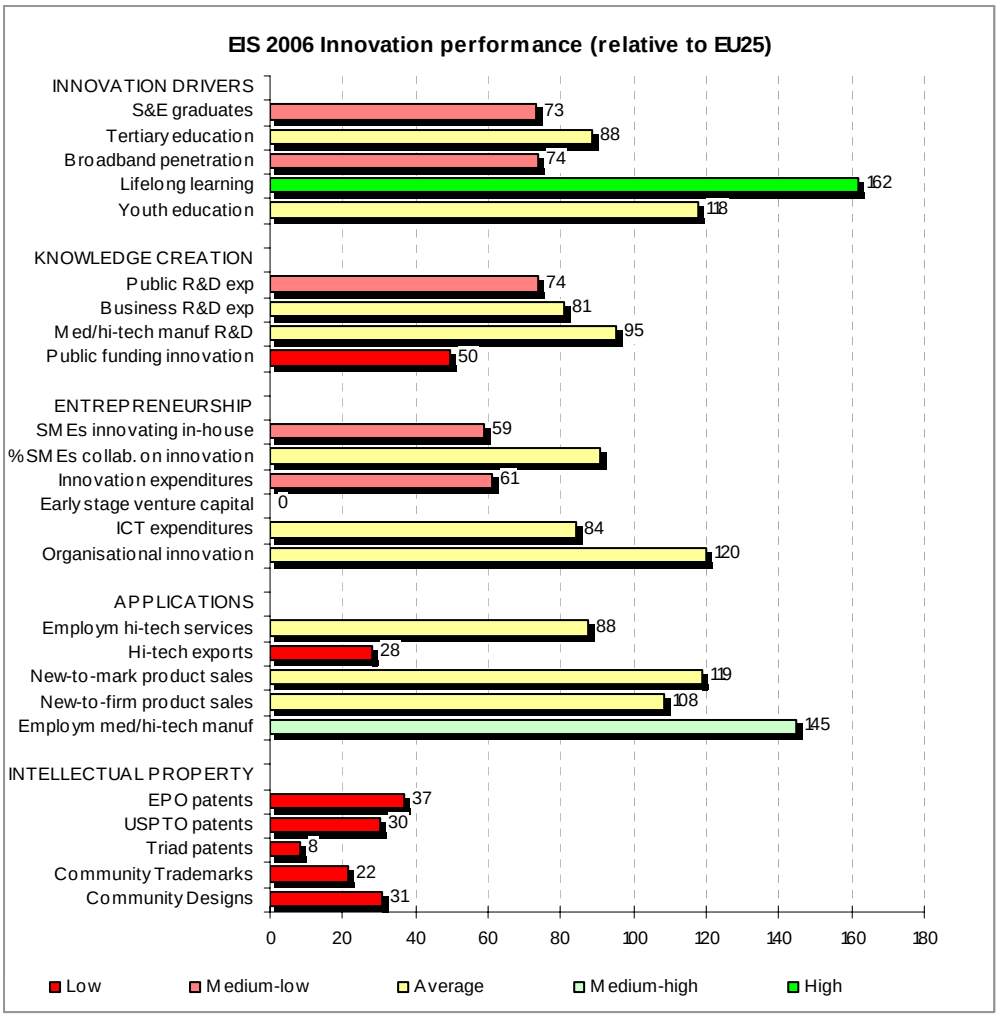
Trend

Indicators in the Application group experienced a strongly positive trend from 1998 to 2005, except for high tech exports. The indicator for S&E graduates is not improving, which may have a negative influence in an otherwise strong group of innovation drivers.

Business R&D expenditures are following a slow positive trend, while public ones were had a negative trend until 2003, when an inflexion took place and the indicator started to improve.

ICT investment has slightly increased over time, while there are not enough data available to establish a trend in broadband penetration.

Figure: Slovenia



SPAIN

Overall performance

The innovation performance of Spain is below the EU average. Considering the latest available data for each indicator, two indicators are performing particularly well, new to firm product sales (10% in 2004) and community trademarks (140.9 per million population in 2005). The indicator for population with tertiary education is also at a higher level than the EU25 average (28.2% in 2005, while EU25 has 22.8%).

Weaknesses are revealed in each group of innovation indicators. Intellectual property is particularly weak in patents, while in the group Innovation & entrepreneurship, early stage venture capital and innovation expenditures are low.

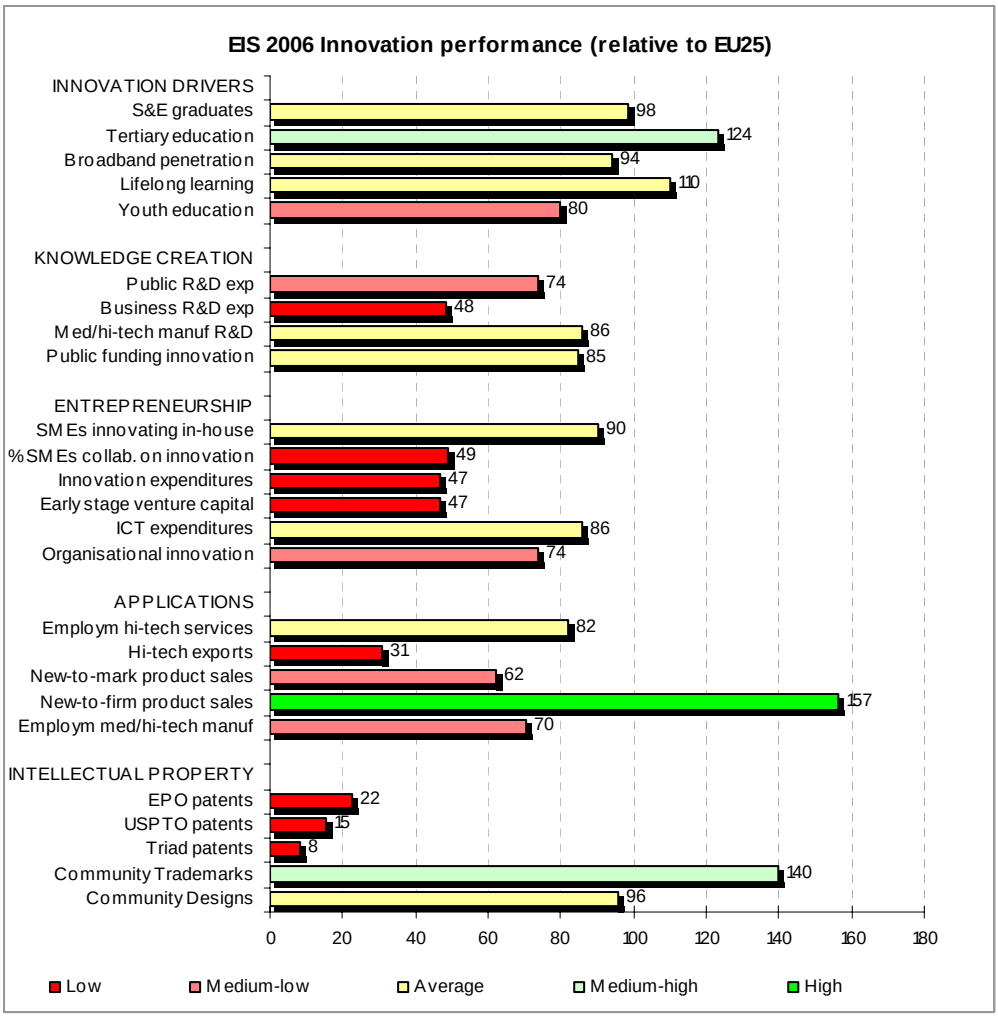
Trend

The trend in Spain's innovation performance is positive for several indicators. Particular attention seems to have been given to innovation & entrepreneurship, where almost all indicators improved their performance (except innovation expenditure).

Also in Innovation drivers, a positive trend took place for population with tertiary education and S&E graduates. Few data are available for lifelong learning, thus it is not possible to establish a trend.

Triad and EPO patents are stationary while USPTO patents present a fluctuating trend. Employment in high tech services increased from 1998 to 2005, while employment in medium-high tech manufacturing services is decreasing slightly.

Figure: Spain



SWEDEN

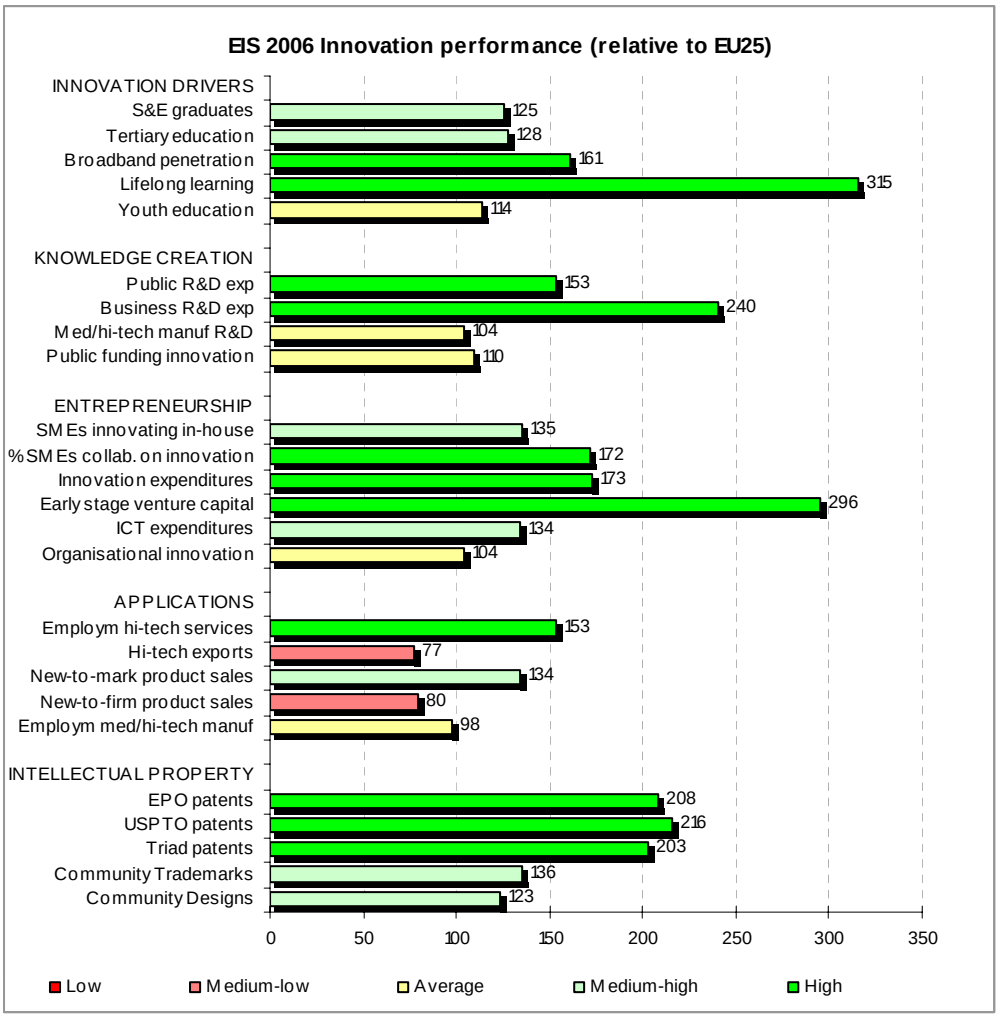
Sweden is among the top performing EU countries with an innovation performance well above the EU average. All 12 indicators available for 2005 are above EU average. Considering the latest available data for each indicator, high tech exports (14.1% in 2004 versus 18.4% for EU25) and new to firm sales (5.1% in 2004 versus 6.4% for EU25) are the only indicators below EU25 average. The strongest indicators are lifelong-learning participation (34.7% in 2005, with respect to 11% in EU25) and early stage venture capital (0.067% in 2005 versus 0.023% in EU25).

Trend

There has not been a positive trend for several indicators, but this is probably due to the fact that the levels were already considerably high and there was little margin for improvement. New S&E graduates improved consistently (from 10.2‰ in 2000 to 12.7‰ in 2004), together with innovative SMEs (from 13.4% in 2000 to 20% in 2004), while ICT expenditures had a fluctuating pattern.

The groups of indicators for Intellectual property and Applications remained stable. These groups include the two weak indicators, which did not improve their performance (high tech exports and new to firm sales).

Figure: Sweden



SWITZERLAND

Overall performance

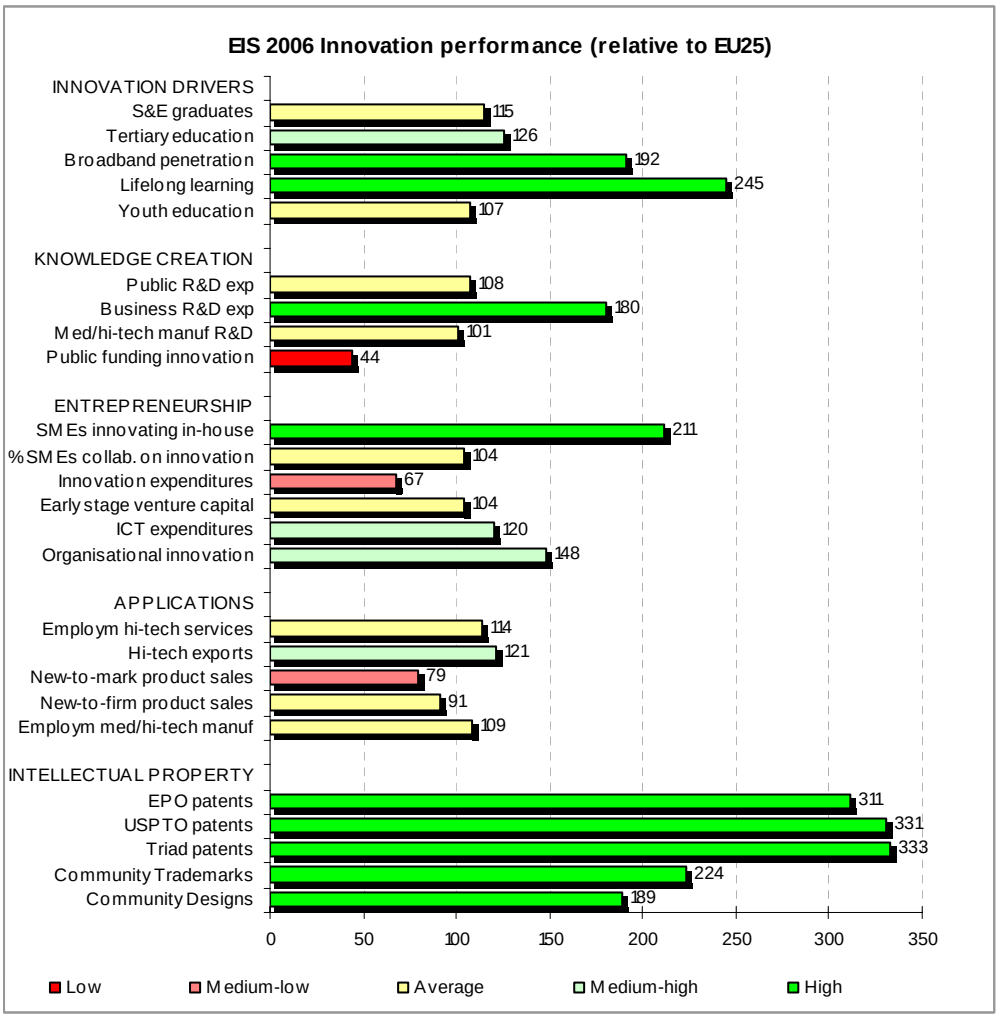
Switzerland is one of the top countries in terms of innovation performance. The figure shows that the majority of the indicators are highly above the EU25 average, while very few indicators are below the EU-25 average. In particular, the indicator for enterprises receiving public funding for innovation is low, with only 4.7% of the total number of enterprises in 2005, against 10.6 of EU25 in 2004. *Intellectual property* and *innovation drivers* are the groups with the best scores.

In 2005, some new data have become available for *innovation & entrepreneurship*, *knowledge creation* and *applications*. These data influence negatively the country performance.

Trend

The trend of Switzerland in the medium term has been better than the EU25 in the groups *innovation drivers*, *knowledge creation* (apart from enterprises receiving public funding) and *intellectual property*. In the other groups there is no clear trend. The number of SMEs innovating in-house has decreased from 54.8% of total number of enterprises in 2000 to 34.4% in 2005, and the employment in the medium-high and high-tech manufacturing has also decreased from 7.70% of the total workforce in 2000 to 7.25% in 2005.

Figure: Switzerland



TURKEY

Overall performance

The assessment of innovation performance for Turkey is very imprecise due the large amount of missing data: 20 indicators are missing for 2005 and some of them are totally missing.

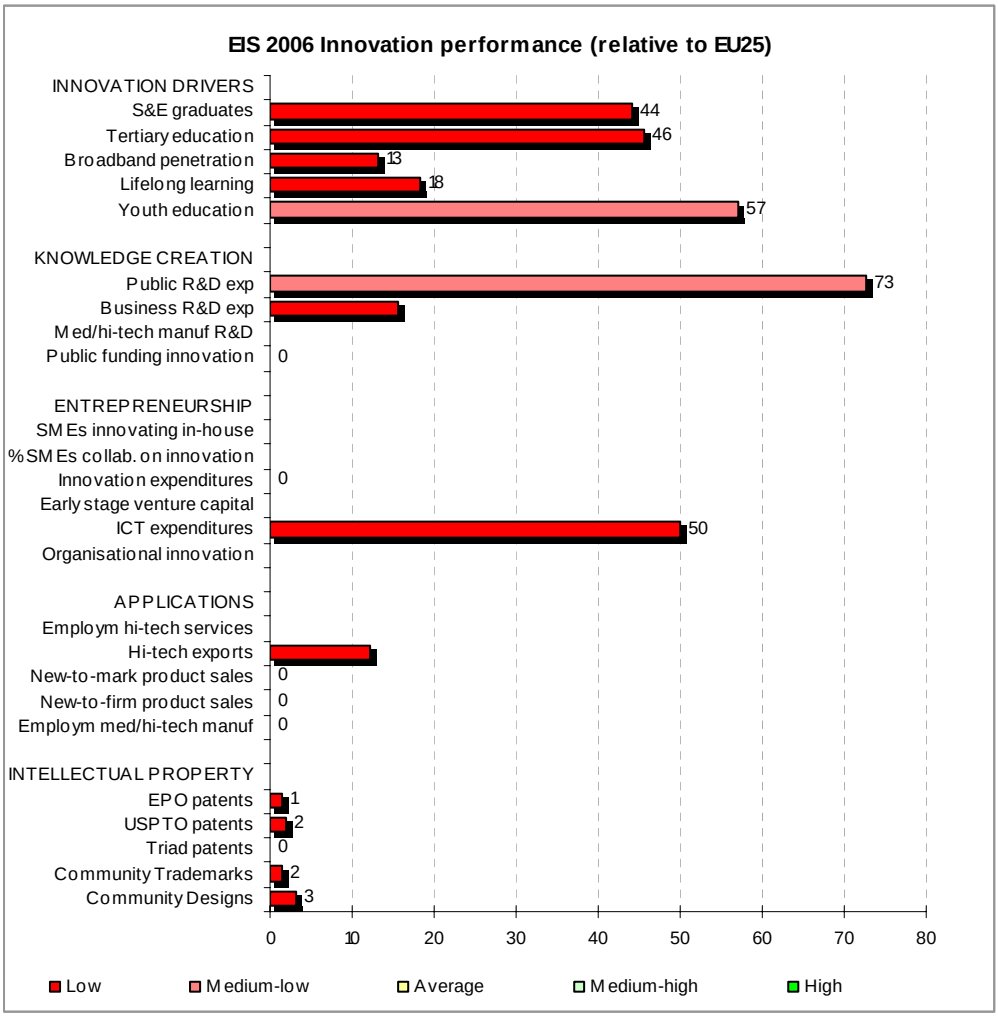
All indicators available are below the EU-25 average. The indicators with high scores are youth education attainment level (44% of population aged 20-24 have completed at least upper secondary education in 2005) and public R&D expenditures (0.48% in 2002). ICT expenditures are 3.2% of GDP in 2003, which is half of EU25 ICT expenditures in the same year.

Trend

There is a positive trend for public R&D expenditures (from 0.34% in 1998 to 0.48% in 2002); USPTO patents and youth education attainment level increased significantly across time (the former doubled from 1998 to 2003, while the latter passed from 38.9% in 2000 to 43.9% in 2005). The number of new Community trademarks in 2005 is three times that of 2001 (1.5 new Community trademarks per million populations in 2005).

All indicators in the groups *innovation drivers* and *knowledge creation* have experienced slight increases, with a notable trend of broadband penetration rate (from 0.5 lines per 100 population in 2004 to 1.4 in 2005). On the other hand, ICT expenditures strongly decreased from 13.1% in 2000 to 3.2% in 2003.

Figure: Turkey



UNITED KINGDOM

Overall performance

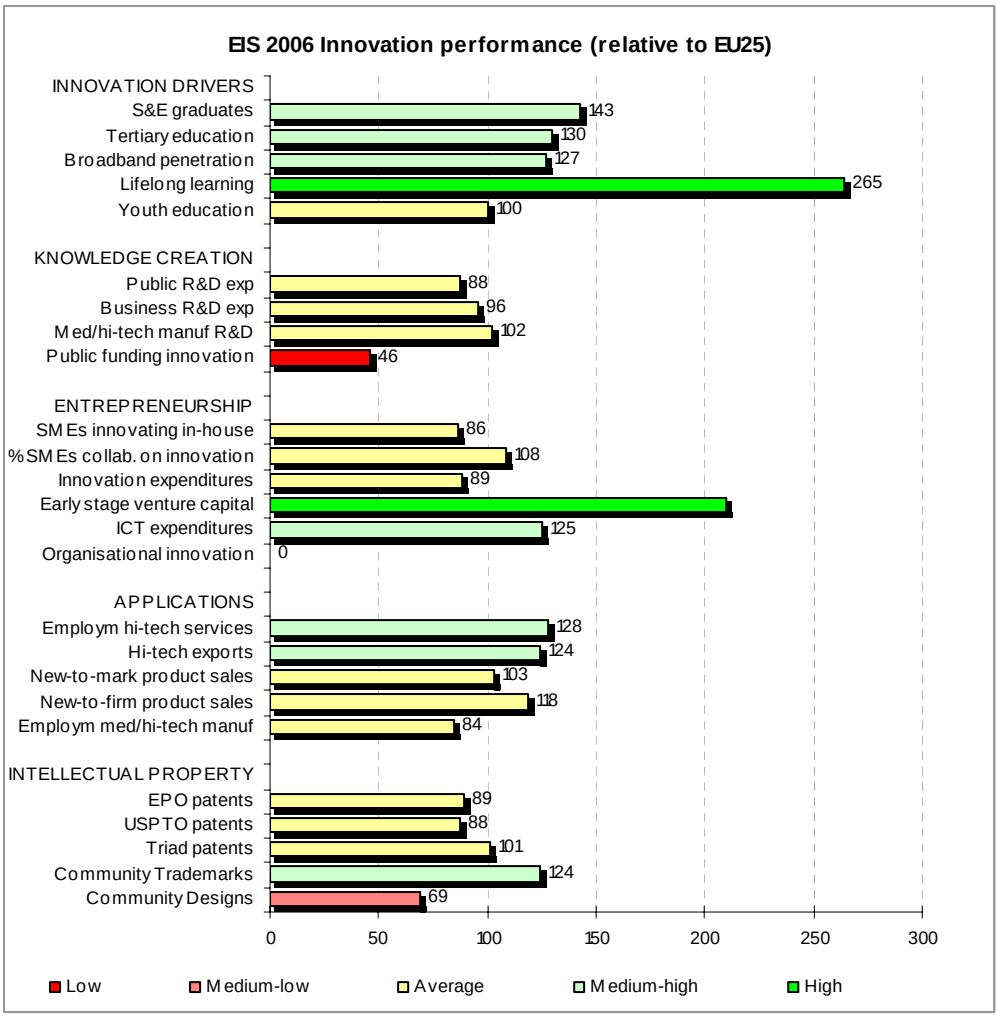
The UK innovation performance is considerably above the EU average. From 10 available indicators for 2005, it follows that the great majority of groups are highly performing, with only intellectual property being below the EU25 average. The strongest indicator for the country is lifelong learning participation (29% in 2005, while EU25 has 11%), followed by early stage venture capital (0.048% in 2005, versus 0.023 for EU25). The weakest indicators are public funding for innovation (share of 3.8 in 2000, while EU25 has 8.3 in the same year) and community designs (76.1 per million populations in 2005, versus 111 in EU25).

Trend

The indicators experiencing a positive trend from 1998 to 2005 are mainly in the Innovation & entrepreneurship group (innovative SMEs in particular, passing from 7.2% in 2000 to 12.6% in 2004). Participation in lifelong learning and sales of new to market products significantly improved as well.

The indicators showing less progress are population with tertiary education, business R&D expenditures and exports of high technology (decreasing from a share of 29.8 in 2001 to 22.8 in 2004).

Figure: United Kingdom



UNITED STATES

Overall performance

Only four indicators are available for year 2005. The figure below shows the latest available data for United States, yet ten indicators are still missing. The United States are naturally very strong in new patents granted at the US patent office (277 per million populations in 2003, against 60.2 in EU25). Moreover, early stage venture capital investments are, in 2003, double than those in Europe (0.072% of GDP against 0.024%). Population with tertiary education is 38.4% of working-age population in 2003 (against 22.8% of Europe in 2005) and R&D expenditures in the business sectors are particularly high (1.87% of GDP in 2004 against 1.2% in Europe in the same year).

The United States does naturally not perform so well is in new community trademarks (33.8 per million populations against 100.7 for EU25 in 2005) and new community designs (17.5 per million

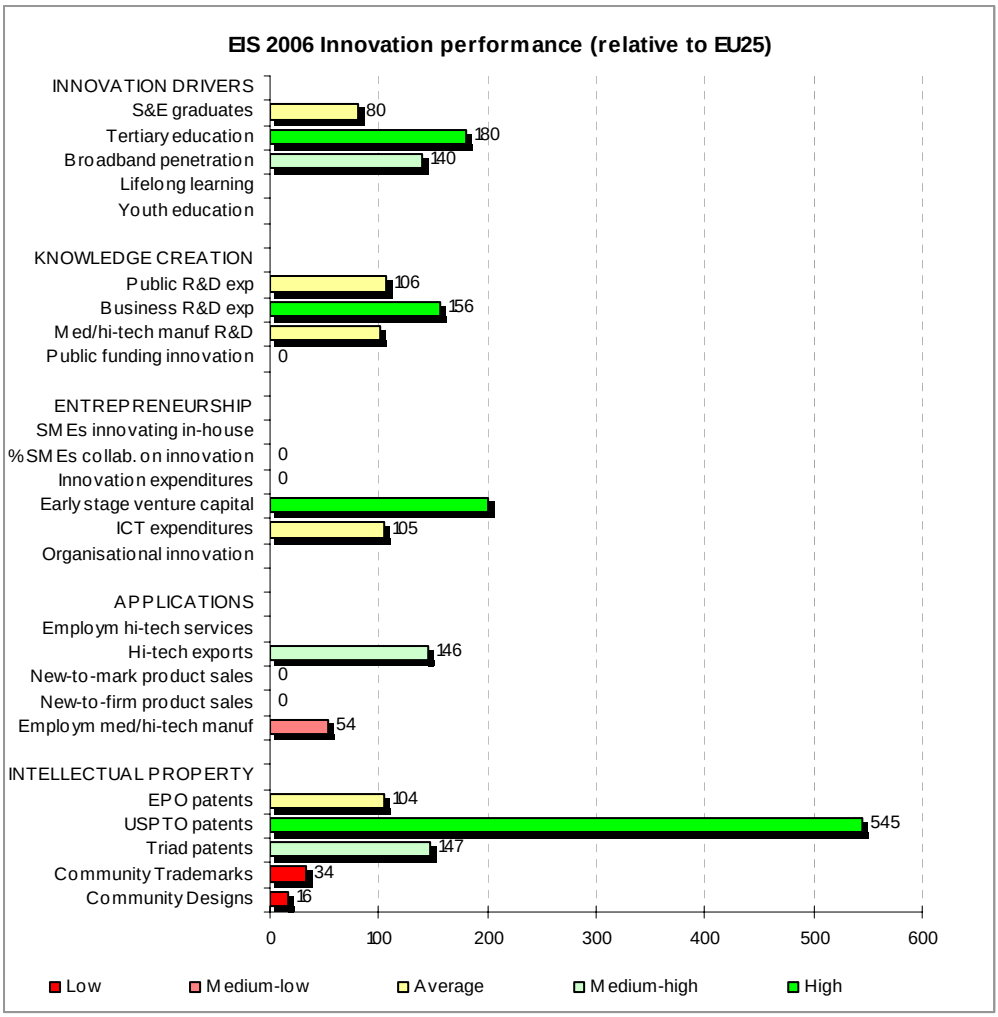
populations in 2005, against 110.9 for EU25). Only 3.84% of total working force was employed in the medium-high and high-tech manufacturing in 2003, while this value is almost double in Europe (7.08% in 2003). All other indicators are in line with the EU25 average, though several indicators are missing and it is not possible to give a complete picture of the country.

Trend

There is no clear overall trend for innovation indicators in the United States. Public R&D expenditures have had a moderate improvement from 0.60% in 1998 to 0.69% in 2004, and broadband penetration rate have increased from 11.3% in 2004 to 14.9% in 2005. New triad patents have also slightly improved from 43.6 per million population in 1998 to 47.9 in 2003.

Early stage venture capital decreased consistently in two years (2000-2002), exports of high-tech products had also a negative trend (from 28.8% of total exports in 1999 to 26.8% in 2004), and medium-high and high-tech manufacturing employment decreased from 4.67% of total workforce in 2000 to 3.84% in 2003.

Figure: United States


EIS 2006 Innovation performance (relative to EU25)
INNOVATION DRIVERS
S&E graduates
Tertiary education
Broadband penetration
Lifelong learning
Youth education
KNOWLEDGE CREATION
Public R&D exp
Business R&D exp
Med/hi-tech manuf R&D
Public funding innovation
ENTREPRENEURSHIP
SMEs innovating in-house
%SMEs collab. on innovation
Innovation expenditures
Early stage venture capital
ICT expenditures
Organisational innovation
APPLICATIONS
Employm hi-tech services
Hi-tech exports
New-to-mark product sales
New-to-firm product sales
Employm med/hi-tech manuf
INTELLECTUAL PROPERTY
EPO patents
USPTO patents
Triad patents
Community Trademarks
Community Designs
80
180
140
106
156
0
0
0
105
146
0
0
54
104
545
147
34
16
0
100
200
300
400
500
600
Low
Medium-low
Average
Medium-high
High

European Commission

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Abstract

This report aims at analyzing behaviour in innovation performance at country level, in order to highlight strengths and weaknesses of the countries considered in the European Innovation Scoreboard (EIS) 2006.

The 25 indicators of the EIS are considered for a total of 34 countries; the EU27, other candidate countries and some of the EFTA countries are described and put side by side with countries such as US and Japan.

An analysis by innovation category shows that Europe[8] is lagging behind United States[9] and Japan with regard to *innovation drivers*, *knowledge creation* and *intellectual property*. For the remaining two innovation categories (i.e., *innovation & entrepreneurship* and *applications*) the available evidence does not allow to draw any inference.

[8] At the time of data compilation and writing this report, Bulgaria and Romania were still not Members of the European Union. So, the words *Europe* or *European Union* in this report refer to the EU25 aggregate.
[9] Consider that many indicators for both United States and Japan are missing and the available ones often refer to prior 2005.

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